the glass industry

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The Glass Industry—1957

By H. E. SIMPSON

State University of New York, College of Ceramics, Alfred University, Alfred, N. Y.

1. INTRODUCTION

• THE GLASS INDUSTRY ENJOYED a good year in 1957, marked by active business but not record production. Flat glass production, which comprises window glass and plate glass, was curtailed approximately 10 per cent below that attained in 1956 owing, in part, to a depressed automobile market. On the other hand, shipment of glass containers should be slightly above that of 1956 which would mean another record year of container production.

Impressive growth records were also made in the field of glass fibers and electronics. The sales volume of the former is estimated to be in excess of $200 million.

The year 1957, among other things, was distinguished by the dedication on May 25th of Houghton Park, named in honor of the founding family of the Corning Glass Works.

The new buildings and the adjacent Corning Glass Center form a harmonious, landscaped architectural grouping. The buildings include: The nine-story administration building—an exterior faced wth black Carrara glass and vertically accented windows; the three-story research laboratory, housing air-conditioned laboratories, offices and scientific library for physicists, chemists, engineers and research administrators; and a one-story development workshop—located directly behind the Glass Center, faced with glass brick to harmonize with the Center exterior.

The research laboratory and development workshop have been named the Eugene C. Sullivan Research Laboratories, honoring the man who is known as the founder of organized glass research in the United States.

For example, 75 per cent of the present business of Corning Glass comes from products which did not exist 15 years ago. With the provision of these necessary additional office and laboratory facilities, the development of new glasses and new products will be stimulated.

These new buildings dedicated to the employees of Corning Glass Works will also serve as a lasting memorial of the contribution of glass to mankind.

Two new plants have been announced by the Corning Glass Works: one at Greenville, Ohio, to manufacture Pyrex brand glass products and a new apparatus plant. The new apparatus plant will be located at Big Flats, near Corning. The factory will manufacture Pyrex brand laboratory ware and will have 176,000 square feet of floor space, including offices and cafeteria. The plant will be much larger than the present apparatus facilities located in Corning, and production capacity will be even greater because of improved manufacturing facilities and plant layout. When these plants are in operation each will employ about 500 people.

Owens-Illinois Glass Company has announced plans for the construction of a new plant near Valencia, Venezuela, South America.

Formation of Sylvania-Corning Nuclear Corporation and the naming of the new company's eight-man board of directors has been announced.

The announcement was made by Sylvania Electric Products Inc. and Corning Glass Works, joint owners of the new firm which has been established for the purpose of expanded research, development and production activities in the atomic energy field.

Sylvania-Corning Nuclear Corporation was incorporated in Delaware and will have its headquarters at the Bayside, Long Island facilities which are presently the headquarters of Sylvania's Atomic Energy Divison.

The advancement of the entire nuclear power industry will depend upon an improvement in the over-all field of reactor materials, components and processes.

To meet this need, the program of the new company will be directed toward the development and production of new and better fuels, reactor materials and components, as well as cheaper and more efficient separation and recovery of spent fuels.

II. FLAT GLASS

Flat glass production, which comprises window glass and plate glass, was curtailed approximately 10 per cent below that attained in 1956. This reduced production was due, in part, to a somewhat leaner automobile market but primarily as a result of heavy imports of plate and window glass from low-wage foreign countries. As a result of the cut in U.S. tariff from 1.55 cents per pound in 1946 to 0.72 cents per pound at the present, foreign window glass imports which amounted to a few hundred boxes in 1946 zoomed to 3,500,000 boxes (50 square feet per box) last year. This influx is estimated at more than 10 per cent of the domestic window glass capacity. Plate glass was also imported heavily over the same period. There has been a growing usage for such glass, however, and it is hoped that 1957 may possibly have seen the greatest impact of foreign competition.

It is significant to note that the selling price of window glass today is only 59 per cent above what it was in 1926. Plate glass prices are actually 2 per cent below those of 31 years ago, whereas during the same period building materials as a whole have advanced 151 per cent, and the average hourly straight-time earnings for employees have increased 450 per cent. To have achieved such results it is obvious that great strides have been made in manufacturing techniques and efficiency.

The automobile industry continues to be a big customer for flat glass and the area of glass used per car is constantly increasing. Harold M. Alexander, General Manager of Development and Research, Libbey-Owens-Ford, commented on an exhibit containing representative windshields and backlights for various models of cars between 1937 and 1957. He pointed out that the 1957 Chevrolet curved backlight is more than three times the area of the corresponding flat part in 1937 and that the 1957 Buick backlight is 50 per cent larger than its 1948 counterpart. The 1937 Cadillac flat windshield was 6.4 square feet in area, as compared with an area of over 14 square feet in the windshield of the 1957 Cadillac Eldorado. The Eldorado windshield is curved not only on the sides, but also along the top to blend into the roof lines. The use of curved parts and greater glass areas has made a very important contribution to safety through reduction of blind spots for the automobile driver and has been an outstanding factor in improving automotive appearance and styling.

The building industry is continuing the trend towards use of curtain walls in large structures, and glass is being recognized as an economical, useful and beautiful material for these walls. This has resulted in Libbey-Owens-Ford's bringing to market this year its new Vitrolux in 16 colors and black and white for spandrels. This is an opaque product made from quarter-inch plate glass with ceramic color fused to the inner or back side of the glass. It is heat-strengthened in the processing.

Vitrolux provides a hard, non-porus polished surface which resists most atmospheric acids and temperature changes. It will not fade, swell, warp, craze, or deteriorate. It is easy to keep clean. It retains its original color and polished appearance and can join with large areas of plate glass wall to provide the architect with interesting reflection patterns.

Parallel-O-Grey is a new twin-ground, neutral grey polished plate glass put on the market this year. It is especially useful in curtain wall construction where reduction of glare is desirable along with transmission of true colors. It is a heat-absorbing glass, useful in connection with air-conditioning systems. This new glass is in quarter-inch thickness with maximum standard sizes of 90 by 120 inches. It reduces transmission of average daylight to 40 per cent, puts the ultraviolet input to 39 per cent and transmits only 45 per cent of total sun energy or heat. Technologists have created, for this glass, a very pleasing grey color.

Rough plate glass blanks in large sheets have been marketed this year primarily for use as interior partitions where good light transmission is desirable along with obscurity. These sheets are 21/64-inch in thickness with a maximum size of 100 by 144 inches. They may be of regular or heat-absorbing type glass.

Another development of 1957 has been the improvement of insulating glass with bondermetic seal using the metal-to-glass bond to seal hermetically the dry air in the space between multiple panes. Although more than 7,500,000 units are in use, much study has gone into suggested improvements. Exhaustive tests have shown that units of fabricated glass with clean-cut edges are less susceptible to breakage than when edges are ground, so that all bondermetic units will be fabricated with clean-cut edges. Now, to protect installation and handling of such edges, they will be enclosed in an aluminum channel which will be attached with a continuous bead of special mastic which will also absorb reasonable impacts on the frame. It is claimed that damage to corners or edge chipping in warehousing or glazing will be greatly minimized by the new type of edge framing.

Full scale production of "Spandrelite" heat-strengthened glass building panels has begun at the Ford City, Pennsylvania plant of Pittsburgh Plate Glass Company.

The unique manufacturing facilities will permit the manufacturer to provide not only faster service with a superior material but will enable him to furnish sizes up to 72 inches by 144 inches.

The new horizontal assembly line is a continuous operation whereby plate glass goes through a wash and dry cycle, then continues through a booth where ceramic color is automatically sprayed. Next the glass rolls on a conveyor through the furnace for heat strengthening, all in one operation.

Spandrelite is now being furnished in 16 standard colors with either a polished plate glass or twill textured surface. Custom colors can be provided and designs may be silk screened in either one or a number of colors if desired. The product can also be manufactured with ceramic color on part of the glass with the remainder transparent.

Unlike surface coatings used on many building panels, Spandrelite color is a fused vitreous material that has the ageless beauty of glass. In building construction, color is mounted to the interior adding the protection of a quarter-inch or more of glass. It is a non-porous, self-cleaning, non-absorbent, stain and odor proof building material. Already a number of large buildings have been and are being built with it.

These include the Civic Center and Supreme Court buildings in New Orleans; American Hardware Mutual Insurance Buildings, Minneapolis; Bloomingdale's Department Store and the buildings at 425 and 430 Park

Avenue, New York; Union Carbide Research Laboratory, Parma, Ohio; Vernor Gingerale Bottling Plant, Detroit; The Colonial Provision Building, Boston; The Grand Masonic Lodge, Greensboro, North Carolina. The largest single usage of Spandrelite, about 100,000 square feet, has been the new Arrivals Building at Idlewild Airport, New York.

Pittsburgh Plate Glass Company has announced the availability of Solargray Twindow double-glazed insulating glass units in sizes up to 50 square feet.

Principal uses for the new Twindow units are for sunny elevations overlooking bright objects, in residences, apartment buildings, hotels, motels, banks, schools, or any building application in which open design requires thermal insulation plus glare reduction and heat excluding properties.

The new Twindow product will be available in metal edge only. It is made of ¼ inch Solargray plate glass and ¼ inch regular plate glass with either ½ inch or ¼ inch air space.

Many important architectural advantages are incorporated in the new insulating glass product. Among these are: a near-black mirror-like outdoor appearance permitting additional achitectural design emphasis on the fenestration pattern; the color-free neutral light transmitting properties of the unit which remove interior decorating restrictions on carpeting, wall, and drapery colors; low (37 per cent) visible light transmission of Solargray Twindow reducing noticeability of venetian blind and drapery positions from the exterior, enhancing the building appearance from outside; better glare control for greater visual comfort without shades providing better visibility and, from a design point of view, a more complete indoor-outdoor integration.

The tendency of color fading is decreased because of lower visible light transmission.

Two new gray glasses, a true heat-absorbing plate glass to be known as "Solargray" and a heavy sheet glass under the "Pennvernon" label have been announced by Pittsburgh Plate Glass Company.

Solargray plate glass is a neutral gray polished plate glass possessing heat absorbing characteristics as defined in Federal specifications. Appearance and functional characteristics of the product are in accord with the expressed needs and desires of the architectural profession, in keeping with the modern trend to multicolored building interiors.

In ¼ inch thickness, the glass transmits approximately 45 per cent of total solar radiant energy and is equal to present greenish-tint heat-absorbing glasses in this respect. Transmission of visible light has been reduced to approximately 40 per cent in order to provide significant improvement in brightness or glare control.

Solargray plate is unique among contemporary glasses in combining these desirable transmittance characteristics in one neutral gray plate glass.

Four primary objectives accomplished in the development of Solargray plate glass are that it provides: excellent brightness of glare control; solar heat control with a pleasing neutral color; elimination of architectural problems in daylight, for interior planning; and a change in the appearance of environment controlling glasses.

III. GLASS CONTAINERS

Increasing consumer preference for glass containers was reflected in overall figures for 1957. Shipments of new glass containers reached a new all-time high. During the past sixteen years, glass container shipments have increased faster than either population or disposable income.

Packaging Industry

Some $10 billion was spent on a total of over 600 billion packages in the United States in 1956. Six types of containers shared the major portion of this market, the remainder going for closures, wrappings, labels, adhesives, and other special applications. These six are shown in Table I.

Table I

	Dollar Volume	Percentage of Total Packaging Market
Paper and Fibre Containers	4,288,000,000	44
Steel Containers	2,034,000,000	21
Glass Containers	743,500,000	8
Wooden Containers	481,000,000	5
Plastic Containers	525,000,000	5
Aluminum Containers	168,000,000	2
	8,239,500,000	85

(Glass Containers Manufacturers Institute)

Re-Use

Many purchasers re-use the same bottle again and again. The average number of trips for milk bottles is 31; soft drink bottles 26; beer bottles 21. Since statistics are available covering shipments of closures used on returnable glass containers, an accurate estimate of total sales of glass-packed units in the United States is possible. The figures show that in 1956 some 77.0 billion, an average of 461 per capita, glass containers "went to market" in the United States—more than any other type of rigid container. For purposes of comparison: shipments of metal cans in 1956 totaled 41.7 billion units. American consumers thus bought almost two glass-packed items in 1956 for every one packed in metal.

End Use

Almost all of the 40 companies engaged in the manufacture of glass containers produce many different styles of wide-mouth and narrow-neck glass containers, which are used to package a diversity of products. While literally thousands of different consumer products were packed in the almost twenty billion containers produced in 1956, all can be catalogued for convenience in one of these four general end use categories: food, beverage, drug and cosmetic, and chemical. (See Table II.)

A comparison of glass container shipments by class for the first eight months of 1956 and 1957 is given in Table III. The greatest increase is to be noted in the "narrow-neck" containers and the most marked increase shown in non returnable beverage bottles. It is also significant to note that the greatest loss is in dairy products and packers' tumblers, both of which are wide mouth containers.

Table II

End-Use	Gross	Units	Percentage of Total Domestic Glass Container Shipments
Food	56,413,000	8,123,472,000	41.0
Beverage	35,925,000	5,173,200,000	26.1
Drug and Cosmetic	33,371,000	4,805,424,000	24.3
Chemical (Household and Industrial)	11,844,000	1,705,536,000	8.6
	137,553,000	19,807,632,000	100.0

(Glass Containers Manufacturers Institute)

Note: Manufacturers report figures in gross, or 144 individual glass containers. Figures used above represent totals in gross (followed by a unit equivalent).

Shipments of glass containers for 1957 were approximately 148 million gross or 21.3 billion units. This figure represents a record year and an increase of about 5.7 per cent over 1956, in which 140 million gross or 20.2 billion units were shipped.

Table III

Glass Container Shipments

First 8 Months 1957*

(Figures are expressed in thousands of gross)

	8 Months		Per cent Change
	1957	1956	
All Types Total	98,518	95,104	+ 3.6
Exports	1,903	1,925	— 1.2
Domestic	96,615	93,179	+ 3.7
Narrow Neck			
Food Containers	10,302	9,732	+ 5.9
Medicinal and Health	11,292	10,783	+ 4.7
Household and Industrial	6,957	6,686	+ 4.1
Toiletries and Cosmetics	6,630	6,474	+ 2.4
Beverage-Returnable	6,516	6,944	— 6.2
Beverage-Nonreturnable	992	865	+14.7
Beer-Returnable	2,053	2,073	— 1.0
Beer-Nonreturnable	6,205	5,991	+ 3.6
Liquor	6,282	6,157	+ 2.0
Wine	2,953	2,985	— 1.1
Wide Mouth			
Food Containers	27,460	25,139	+ 9.2
Medicinal and Health	3,440	3,411	+ 0.9
Household and Chemical	1,530	1,494	+ 2.4
Toiletries and Cosmetics	1,853	1,845	+ 0.4
Dairy Products	1,483	1,661	—10.7
Packers' Tumblers	667	939	—29.0

*U.S. Department of Commerce Facts for Industry

IV. GLASS FIBERS

Glass fibers have been created out of research. The industry's policy of intensive research, continuing product and process development, and creative engineering is vital to its sustained growth. Impressive growth records continue to be made in this relatively young branch of the glass industry. It is estimated that the sales volume for 1957 was in excess of $200 million.

A major accomplishment, which has grown out of experiments carried on over a period of several years, is the development of a new forming process capable of high speed production of wool products possessing improved insulating values, lighter weight, and better handling properties. This material is now being produced for residential building insulation in roll blankets and batt forms. Improved insulations for the transportation and appliance markets have also been made by this advanced process, and, as experience is gained, the advantages may be applied to materials for other uses.

Another significant process development applied after several years of experimentation was a redesign of continuous textile filament forming equipment to produce strands having double the number of filaments, each of finer diameter, thus upgrading yarns for draperies and curtains. This is a new form of marketing bulked-up yarn for decorative fabrics. It promises to broaden further the textures and styles of glass fiber fabrics which may be created.

During the year, there have been made available to fabric converters improved finishes to be applied to casement curtains and draperies, for better resistance to soiling and sun fading, and to sheer marquisette curtains for greater whiteness. Lower cost methods of roller printing glass fabrics have also been developed.

New products include a mat-faced ceiling board that has won rapid market recognition and wide usage in supermarkets, schools, public, and commercial buildings.

Development of a new type of dust-catching air filtration product increases the range of glass fiber products for these uses. Also being field tested is a frameless filter for window air-conditioning units, designed for ease of replacement and disposal.

Product improvements in temperature characteristics, impact and tensile strengths and handling properties have been made on pipe coverings and other industrial materials, roof insulating and form boards, and corrosion protective mats.

Considerable work has recently been carried out with molders of reinforced plastics using glass fibers. A program is well advanced to evaluate and assemble engineering design data to be issued in readily usable form for manufacturers of reinforced plastics. These data cover many techniques and materials entering into the manufacture of a variety of finished items and components, including boats, containers, vehicles, sporting equipment, appliance parts, piping, and building panels. The work in the glass fiber reinforced plastic field is being intensified to accelerate sound usage of these materials in additional significant ways.

Glass in thin flake form is being supplied in trial quantities for testing in end uses where reinforcement, moisture resistance, electrical, or light controlling properties are desired.

Fiber Glass Tool Handles

The first line of hand tools ever made with handles guaranteed not to break, bend out of shape, or collapse have been placed on the market.

The fiber glass handles cannot rust, rot or corrode. They are stronger and lighter than steel, yet can be molded into the traditional grip-shape of wood handles with the feel of shock-absorbing hickory. This quality

permits retaining all of the advantages of hickory, with none of the disadvantages, and at the same time making use of a metal head with full weight and maximum striking force.

The metal head of each tool is permanently joined to the handle with Permabond which eliminates the use of wedges. Permabond is a chemical weld which binds the head and handle into one unit.

Pre-saturated Glass Yarn

A pre-saturated glass yarn is being introduced by Owens-Corning Fiberglas Corporation to manufacturers of non-metallic sheathed building cables, service entrance cables, and rubber-covered building wire.

The new yarn, pre-saturated with a bituminous material, is the only one of its type now commercially available. It has been widely field-tested and has passed all underwriters' tests. It permits sharply increased braiding efficiency and improved adhesion of braids and wraps to the outer finish.

Two New Screened Patios

The swing to outdoor living is receiving major boosts with the introduction of two new screened patios: an assemble-it-yourself kit called Screenlite and a custom model known as Homeshield.

Each of the newly designed patios consists of aluminum framed glass fiber screening and a roof of glass fiber translucent reinforced plastic. They can be installed against the side of the house.

The Screenlite, a three-sided structure designed as an outdoor extension of the living area, consists of three-foot wide screened panels. It can be purchased in the minimum standard size of 9 foot x 12 inches and later expanded by additional panels.

The three-foot panel frame screening consists of glass fibers coated with tough vinyl. Like glass in its other forms, this screening cannot rust, corrode, shrink, stretch, dent, or burn. It is the strongest screening made.

Packaged Ceiling

The first major installation of a new type of "packaged ceiling", combining an incombustible glass fiber acoustical board with a Lock-Electric suspension and lighting system is being used in Fairchild Camera and Instruments Corporation's new air cooled engineering building at Syosset, Long Island, New York.

The new 60,000 foot ceiling is part of Fairchild's new headquarters for expanding research development, and system engineering facilities. Owens-Corning officials pointed out that the Lok systems in conjunction with fiber glass tile or ceiling board prove that "better ceilings, better acoustics, better appearance plus better lighting can all be realized at no greater cost than the least expensive installations."

Crush-Proof Ties

Glass fibers have found another big consumer application. This time it's in neckties. Used as a functional filling in the backing of acetate ties, glass fibers make them crush-proof. They represent the first new neckties in recent years, and are the result of 15 years' research.

Special fiber glass yarns developed by Owens-Corning are designed for use in finer fabrics and serve as a "secondary functional filling" in this new neckwear fabric. The filling is the horizontal direction of the weave; the warp is the vertical direction. Acetate yarns are used in the warp direction and as the decorative component of the filling. About 22 per cent of the tie by weight is fiber glass, the remainder is acetate.

Tested by consumer panels, the tie has been found to possess an amazing "spring-back" quality, thanks to the presence of glass fibers. The tie has been worn daily for as long as five weeks with minimum signs of permanent wrinkling. Extensive marketing and promotion plans have been made for these materials.

Glass Fiber for Noise Control

Fiber glass noise control products are basically porous products of fibrous glass. They possess all the advantages important to good sound control installations.

These products trap noise in the millions of tiny, dead air cells formed by their maze of glass fibers.

They reduce danger of ceiling failure due to warping, buckling, expansion or contraction of tile.

They are unaffected by short term extreme humidity, may often be applied in new buildings without the waiting time required by moisture-sensitive materials.

They are among the lightest weight inorganic-type, fire-safe acoustical materials available. All tile and board products weigh less than one pound per square foot. This feature means added security in application, especially where adhesives are used.

In addition to acoustical properties, these products afford excellent thermal insulation. The k-factor of the basic material used in acoustical tile and ceiling board is 0.24 Btu per hour per square foot per inch of thickness per °F. at 75°F. mean temperature.

They will not absorb or give off odors. They will not rot or decay and offer no sustenance to bacteria, termites or vermin. Numerous installations in hospitals and other critical areas have demonstrated this sanitary feature.

Glass fiber noise control products should not be applied against or below surfaces which are subject to frequent condensation; under conditions which will cause acoustical materials to remain wet; or in areas of constant high humidity. The products should be used in areas which are subject to physical abuse. Attachments with nails or screws is not recommended. They should not be used where continuous or intermittent temperatures exceed 150°F. or where extreme variations in relative humidities are expected.

Some of the newer products in this field are as follows:

Textured Acoustical Tile: fiber glass textured acoustical tile is a highly decorative, washable material with a white textured appearance and excellent light reflecting properties. It provides efficient noise reduction and sound control. The surface has a pleasing, soft appearance that lends quality and beauty to interior design. It has a white bevel edge.

Random Perforated Acoustical Tile: fiber glass random perforated acoustical tile is painted with a non-gloss white paint and cleanly drilled with irregularly-sized holes spaced in a random pattern. Random perforations blend into an informal over-all ceiling pattern of distinctive beauty. Available with easily maintained

white finish, it may be had in several sizes.

Sonofaced Acoustical Tile: sonofaced acoustical tile is a standard glass fiber tile faced with a decorative plastic film in a choice of patterns and colors. The film vibrates and effectively transmits sound to the sound absorber. This tile fills the need for an acoustical material with high sound absorption, light reflection and a smooth, easily maintained finish—plus the decorative advantages of attractive color.

Stria Acoustical Tile: fiber glass stria acoustical tile offers a handsome concept in ceiling design. The surface of multiple parallel striations or grooves permits great variety in ceiling patterns and provides effective noise reduction. It creates a pleasing soft appearance that lends quality and beauty to interiors.

Fresco Acoustical Tile: this tile introduces a new, unique ceiling appearance never before possible with noise control products. The softly stippled surface results in graded shadows which conceal joints and produce a pleasing completely random effect. This attractive appearance plus high noise absorption make this an ideal acoustical ceiling for any room.

Ceiling Board: fiber glass ceiling board is a rigid, lightweight, board of fibrous glass. Ceiling board is designed for use on grid supporting systems of metal T-sections. The boards, with the exposed-T of the suspension system, forms an attractive ceiling for use with modern or traditional decor. Wide range of sizes permits modular simplicity.

V. GLASS BLOCK

Glass block production in 1957 was approximately the same as it was in 1956—a record year.

The practical, conservative glass block has been given new glamour by the introduction of colors—blue, green, yellow, and coral. The colored block possesses a medium light transmission range of about 25 per cent.

Long known to architects for an unusual combination of advantages found in no other building material, it has found a ready market in schools where diffused, natural lighting without glare is a prime factor. In addition, a growing use of replacing worn and dilapidated sash has developed.

These new glass blocks allow the entry of diffused natural light supplemented by the effect of glowing color.

Engineers have long felt that glass blocks possessed an unusual number of advantages as a wall material rather than just a means of filling a window space. One of the earliest examples of this use is the Layton School of Art designed by John B. Waldheim Associates in Milwaukee. This pioneer project points up one fact—the practicality of the technique. The building has been in use seven years with no maintenance problems of any sort.

The advantages of "curtain walls" are manifest. One of the most important is economy. A glass block curtain wall can be erected at a lower cost than most conventional curtain wall materials. Some of this saving is due to the fact that one trade installs the entire wall. The wall goes up quickly; there is no waiting for other crews. When it is up, it is a finished wall, inside and out.

Glass blocks have a very respectable U factor—the equal of an eight inch masonry wall. There is no corrosion and few, if any, maintenance problems. The blocks are practically self-cleaning.

The addition of color to glass blocks, together with the curtain wall technique, gives the architect an unparalleled freedom of design not only in adding color where he chooses on the exterior of his building, but allows the double use of the color in presenting a glowing wall of color on the exterior and interior both by day and night.

With the introduction of new colors for glass block and the added emphasis on glass block curtain walls, there is every indication of a rising trend and extended market.

VI. ELECTRONICS

The electronics industry had a most successful year during 1957 and in most instances production was equal to that of 1956, a record year. Because details of production are available for 1956, such data are herewith presented, and various estimates are given for 1957.

The industry established a new record during 1956. Factory sales of radios, televisions, phonographs, military and industrial equipment, and components were $5.9 billion. When distribution, servicing, and broadcasting revenues are added, the industry value totals $11.6 billion—twice the value of 1950 billing but only half that anticipated by 1965.

The year 1956 saw the emergence of portable television receivers as an important new product for consumers. Factory sales were 1.7 million compared to 286 thousand during 1955 (the first portable TV year). Consumers enthusiastically endorsed another one of the industry's new products, the transistor radio, by purchasing 986 thousand units from manufacturers.

After remaining relatively constant during the years since the Korean War, 1956 military electronic expenditures rose to $2.7 billion. This is twenty-seven times the 1941 expenditure of $100 million and more than a third of the $7.5 billion procurement during the entire World War II period from 1942 to 1946.

Factory sales of industrial electronic equipment reached $950 million during 1956. Aided by the rapid expansion of closed circuit television and new uses for electronic computers, 1956 industrial electronic sales registered a 20 per cent gain over 1955 sales. New electronic applications in heating and air-conditioning equipment, the growth in use of commercial sound equipment, the spread of automation, etc., are expected to push the value of industrial electronics to $2 billion by 1965.

Radios, Televisions, and Phonographs

The year 1956 was also significant as the radio industry passed the 250 million production mark. Since commercial radio broadcasting was authorized in 1920, more than 258 million radios have been made and sold by factories for $6.5 billion. Approximately 150 million radios are now in use being served by 3,024 AM (amplitude modulation) and 528 FM (frequency modulation) stations. Ninety-eight per cent of American homes have one or more radios.

Factory sales of electronic phonographs reached an all time high during 1956. Sales of 3.3 million units were ten times greater than sales during the best prewar year (1940) and one and one-half times greater than

Table IV

Manufacturers' Sales of Picture Tubes by Screen Size*

(RETMA Fact Book 1957)

Year	15 Inches and Under	16-18 Inches	19-21 Inches	22-25 Inches	26 Inches and Over	Projection
1948	1,145,583	9,123				154,470
1949	3,316,767	179,682				16,601
1950	2,365,380	5,356,102	211,950			23,645
1951	437,148	3,586,976	973,233	120,739		17,703
1952	296,753	3,004,786	4,296,735	30,409		6,983
1953	267,380	3,065,102	6,105,068	275,504	119,964	6,120
1954	235,954	2,086,077	7,223,259	318,665	46,925	2,624
1955	412,226	1,805,081	7,674,175	948,104	34,648	**
1956	1,447,978	997,830	4,493,682	593,224	7,121	**

* Made from new glass.

** Included with 15" and under.

sales during the previous record year of 1955. During the same year, 526 thousand phonograph combinations, 312 thousand record player attachments, and 450 thousand miscellaneous types also were produced and sold by factories.

Military and Industrial

With electronic principles being used increasingly in military equipment, the growth in the nation's expenditures for national defense emphasizes the expanding importance of the military electronic market.

Military

Research and development are to continue at record levels. One half of these expenditures are made by government reserve facilities and one-half by industry and universities, according to a 1956 study by the National Science Foundation. For fiscal 1957-58, new research and development obligational authority will be $1.6 billion. Expenditures will be $1.58 billion currently.

During the calendar year 1956, the electronics portion of defense expenditures equalled $2.7 billion. This information is shown on the following table by budget categories in millions of dollars, taken from the RETMA Fact Book 1957.

Budget Category	Fiscal Year 1955-56
Aircraft	$ 925.0
Ships and Harbor Craft	80.0
Combat Vehicles	9.5
Support Vehicles	5.8
Guided Missiles	630.0
Electronics and Communications	770.2
Research and Development	265.0
Miscellaneous	47.5
	$2,733.0

Industrial

Industrial electronic equipment is helping to speed the hardening of metal parts, rectifying current in the making of aluminum, solving problems in seconds that would otherwise require hundreds of years of mathematical calculations, and revolutionizing America's production techniques in these and many other ways.

During 1956, industrial electronic apparatus sales were $950 million—nearly three times 1950 sales but less than half that anticipated during 1965.

Users of mobile radios and microwave relays provide one of the more important markets for industrial electronics. At the end of the year, 362,473 stations were authorized by the Federal Communications Commission to operate nearly a million transmitters for two-way communication by railroads, buses, emergency vehicles, etc.

Parts and Tubes

Parts and tubes, the nerve centers of electronic equipment, control the flow of electrons by storing energy and changing the relationship between current and voltage.

The receiving tube is one of the most important controlling devices. During 1956, manufacturers sold 464 million units valued at $374 million. Of this number, 167 million were sold for replacement setting a new record for the renewal market. Sales of receiving tubes for use in new radios, televisions, phonographs, electronic computers, aircraft and other industrial equipment totaled 263 million units.

Manufacturers sold more TV picture tubes during 1956 than during any previous year. The 10.9 million units were valued by factories at $196 million. In response to consumer demand for portable television receivers, sales of 14 inch and smaller picture tubes totaled 1.4 million during 1956—more than three times 1955 sales. Reflecting this change in consumer preference, 1956 sales of 17 inch tubes declined from 1.8 million in 1955 to 998 thousand and sales of 21 inch tubes were down from 7.7 million to 4.5 million.

Sales of all tubes and parts reached $2.2 billion during 1956, an all time high. An estimated $1.35 million of this amount represents sales for installation in new equipment. Component sales for replacement totaled $850 million.

VII. PYROCERAM

The development of a whole family of new wonder materials has been announced by Corning Glass Works.

The basic materials are harder than high carbon steel, lighter than aluminum, and up to nine times stronger than plate glass.

Table V

Manufacturers' Sales of Receiving Tubes by End Use

(000 Omitted) (RETMA Fact Book 1957)

Year	Initial	Renewal	Export	Gov't.	Total	Value
1922					1,000	
1923					4,500	
1924					12,000	
1925					20,000	
1926					30,000	
1927					41,200	
1928					50,200	
1929					69,000	
1930					40,213	$ 37,930
1931					47,696	25,505
1932					47,453	18,299
1933					62,762	23,147
1934					63,247	24,245
1935	41,006	28,060	6,896		75,962	26,565
1936	58,579	30,882	8,843		98,304	31,942
1937	54,599	27,210	10,247		92,056	29,871
1938	42,373	24,917	7,401		74,691	23,093
1939	65,284	25,375	7,841		98,500	27,985
1940	72,249	28,994	7,233		108,476	27,610
1941	92,031	33,782	10,025		135,838	47,500
1942	64,640	36,495	6,612		107,747	43,000
1943	54,507	19,637	3,106	32,828	110,078	51,000
1944	60,207	20,899	4,552	43,405	129,063	62,140
1945	57,235	40,462	4,995	36,786	139,478	68,500
1946	129,637	65,228	9,991	361	205,217	101,000
1947	131,987	43,530	23,184	833	199,534	107,000
1948	146,162	47,056	10,687	815	204,720	112,000
1949	147,298	39,696	10,073	1,686	198,753	119,000
1950	301,483	69,325	10,768	1,385	382,961	250,000
1951	247,855	94,597	24,438	8,754	375,644	261,000
1952	241,406	83,843	13,935	29,335	368,519	259,116
1953	293,601	112,785	20,614	10,091	437,091	303,675
1954	246,729	115,358	15,922	7,080	385,089	275,999
1955	288,810	150,718	24,442	15,832	479,802	385,110
1956	262,898	166,558	25,397	9,333	464,186	374,186
Estimated 1957	209,700	160,400	19,320	6,848	396,400	.....

Table VI

Manufacturers' Sales of Picture Tubes by End Use*

Year	Initial	Renewal	Export	Gov't.	Total	Value
1947					274,008	$ 7,756,203
1948					1,309,176	33,459,554
1949	3,305,673	202,663	4,459	255	3,513,050	98,136,591
1950	7,473,614	472,261	11,184	8	7,957,067	210,714,743
1951	4,434,126	674,284	21,343	6,046	5,135,799	122,224,186
1952	6,120,292	1,431,952	83,372	50	7,365,666	170,652,079
1953	7,583,225	1,800,185	451,476	4,252	9,839,138	234,861,041
1954	7,514,691	1,808,324	590,051	438	9,913,504	206,075,994
1955	7,751,853	2,360,813	760,680	888	10,874,234	209,007,518
1956	7,539,835	2,725,696	721,416	74	10,987,021	196,220,240
Estimated 1957	4,899,000	2,489,000	660,100	286	8,315,000	.....

*Made from new glass.

Called Pyroceram, the company trademark for its crystalline materials made from glass, this entire group of new engineering materials can be made with a variety of properties.

It is made by adding special ingredients to the raw materials of a glass batch. After the glass has been cooled to solid form, it goes through a heat-treating process. This transforms it from glass into an extremely hard, fine-grained substance.

The new materials are melted and formed like glass, with each batch containing one or more nucleating agents. Subsequent heat treatments cause the nucleating agents to form billions of submicroscopic crystallites in the Pyroceram. As the heat treatment continues, each crystallite acts as a center of crystal growth.

It is by controlling the chemical composition and growth of these crystals that Pyroceram is made with a variety of properties.

The end product, after heat treatment, is an extremely fine-grained crystalline material, nonporous, impermeable, and harder than most ceramics and many metals.

Unlike most high-strength, high temperature crystalline materials, Pyroceram has great flexibility in forming. It can be made into large or complex shapes by any of the known glass-forming techniques. It is adaptable to mass production, and can be pressed, drawn, blown, rolled and centrifugally cast.

Pyroceram can be tailor-made with thermal expansions ranging from slightly negative to high enough to match those of heavy metals.

Pyroceram products can be made in almost any shape. The material starts as glass and can be formed like glass by conventional blowing, pressing, drawing or spinning techniques. It can even be cast like metals.

Over 400 different compositions have been developed. The first commercial use of these new materials will be for guided missile radomes.

Its fire resistance, lightness and strength would make it desirable for curtain walls and other architectural uses. Another advantage in formability, is the fact that certain types can be formed by investment casting techniques.

Experimental Pyroceram compositions have flexural strengths as high as 60,000 pounds per square inch.

Pyroceram will probably cost little more than glass and far less than stainless steel. In final form, it can be transparent, opaque, or milky white.

Pyroceram is claimed by Corning to be one of the greatest technological advances in glass research since the discovery of heat-resistant borosilicate glass early in the 20th century.

Its first use will quite likely be in radome nose cones for guided missiles. They have proven superior to other products because of their resistance to rain, erosion, and their improved ability to receive and send out electrical signals. The cone protects the sensitive directional instruments in the nose of the missile from the sudden high temperatures experienced in hypersonic flight. The softening point of this Pyroceram is 2460°F., which is above the melting point of some stainless steels.

VIII. RAW MATERIALS

The glass industry is constantly alert to the prospect of new materials that may enhance or provide new and unusual properties for products. The fluxing power of alkali carbonates, such as sodium carbonate and potassium carbonate, has been known for many years. However, according to recent announcement by the American Potash and Chemical Corporation, there is now available for evaluation two additional compounds, namely rubidium and cesium salts.

The following compounds are now obtainable at a price which is only a fraction of that charged formerly.

Rubidium Compounds*

(Technical Grade 95 Per Cent Minimum Assay)

Rubidium Carbonate	$15.00 per pound
Rubidium Chloride	14.50 per pound
Rubidium Fluoride	17.00 per pound
Rubidium Sulphate	13.00 per pound

* For any quantity up to 100 pounds.

Cesium Compounds*

(Technical Grade 93 Per Cent Minimum Assay)

Cesium Carbonate	$25.00 per pound
Cesium Chloride	24.50 per pound
Cesium Fluoride	27.50 per pound
Cesium Sulphate	22.50 per pound

* For any quantity up to 100 pounds.

The availability of these fundamental materials in high purity provides the glass and ceramic industry with the possibility of creating new glasses with possibly startling properties.

In general, rubidium compounds resemble the compounds of the other alkali metals. However, significant differences are evident because of variation in ionic dimensions, different heats of hydration and the ease with which the outer electron is lost. Since the reactivity and the properties of specific alkali metal compounds depend to a large extent on the properties of the metal or cation involved, Table VII, showing some of the properties of the alkali metals, is presented for consideration in specific applications. Table VIII lists some of the properties of rubidium compounds.

A similar series of cesium compounds are also available for commercial evaluation.

Although cesium has properties similar to the other alkali metals, it is the most reactive member of the group. Because of its greater atomic weight and radius, pronounced differences exist as evidenced by comparing the solubilities of various salts in water and comparing the ionization potentials of the gaseous atoms.

Table IX is indicative of some of the properties of the cesium compounds.

The action of these higher atomic weight alkali metals in glasses is not specifically known. It is quite probable, however, that definite effects will be noticed with such properties as rate of melting, softening point, viscosity, workability, annealing, density and refractivity. The problem of durability may also be influenced. Colors and electrical properties are also known to be profoundly influenced by size and mobility of the alkali cation. One would expect rubidium to react similarly to potassium only more so because of its ionic radius and mobility. Cesium, on the other hand, is very reactive and may show

Table VII.

Properties of Alkali Metals (1)

Property	Lithium	Sodium	Potassium	Rubidium	Cesium
Atomic Weight	6.940	22.997	39.096	85.48	132.91
Density (20°C)	0.534	0.97	0.86	1.53	1.90
Melting Points, °C	186	97.5	63.7	38.5	28.5
Important Spectral Line	6707.8A	5890A	7664.9A	7800.2A	8521.1A
Ionization Potential of Gaseous Atoms, Volts	5.37	5.12	4.32	4.16	3.87
Volume of ions x 10^{23} cc.	0.14	0.37	0.99	1.36	1.95

Table VIII.

Properties of Rubidium Compounds

Property or Value	Rubidium Compound Carbonate	Sulphate	Chloride	Fluoride
Molecular Weight	230.97	267.02	120.94	104.48
Melting Point, °C*	835	1074	717	775
Heat of Fusion, Kcal/mole*	.....	.....	4.40	4.13
Heat of Formation, Kcal/mole* at 25°C	–269.6 (c) –278.0 (aq)	–340.50 (c) –334.7 (aq)	–102.91 (c) –98.9 (aq)	–131.28 (c) –137.6 (aq)
Specific Heat, cal/deg mole*	28.4	.....	12.3	12.2
Boiling Point at 760 mm Hg*	decomposes	.....	1408°C	1381°C
Heat of Vaporization, Kcal/mole*	.....	.....	36.92	39.51
Solubility in Water** Grams/100 gms H_2O Ca 25°C	222.7	48.1	91.2	130.6

*Reference (2) *Selected Values of Chemical Thermodynamic Properties*, NBS Circular 500, (1952).

**Reference (3) *The Chemical Elements and Their Compounds*, Vol. I, N.V. Sidgwick, Oxford University Press (1950).

Table IX

Properties of Cesium Compounds

Property or Value	Cesium Compound Carbonate	Sulphate	Chloride	Fluoride
Molecular Weight	325.82	361.88	168.37	151.91
Melting Point, °C*	decomposes	1019	645	682
Heat of Fusion, Kcal/mole*	.....	.....	3.60	2.45
Heat of Formation, Kcal/mole* at 25°C	–267.4 (c) 1278.6(aq)	–339.38 (c) –335.3 (aq)	–103.5 (c) –99.2 (aq)	–126.9 (c) –135.9 (aq)
Solubility in Water** Grams/100 gms H_2O Ca 25°C	261.5	179.1	185.8	366.5

* Reference (1) *Selected Values of Chemical Thermodynamic Properties*, NBS circular *500*, (1952).

** Reference (2) *The Chemical Elements and Their Compounds*, Vol. I, N. V. Sidgwick, Oxford University Press (1950).

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other properties and characteristics. The possible applications of these interesting new materials are extremely great in effecting crystal growth or crystal formation or in modifying glass properties.

Lithium minerals are being improved and becoming more readily available. The current year's consumption of lithium minerals by the ceramic and glass industries has somewhat changed over the past several years and substantial further changes are in prospect. The total consumption this year is estimated to be the equivalent of, if not slightly higher, than last year's 18,000 tons.

Lepidolite use has increased over petalite and the consumption was approximately 9,000 tons each. Approximately two-thirds or 6,000 tons of lepidolite went into television glass and the balance into borosilicate glass. A negligible amount was used in other glasses and in ceramics. The "other glasses" actually include several hundred tons in porcelain enamels. Of the 9,000 tons of petalite consumed, approximately 60 per cent went into television glass, none into borosilicate, with the balance going into whiteware ceramics, and porcelain enamel frits.

Basic glass research involving lithium oxide was broadened during 1957. The lithium chemical producing industry sponsors of the American Lithium Institute have established a basic study of lithium in glass.

During this year there have been broadened studies by both Canadian as well as domestic manufacturers to develop a glass grade of spodumene. The total output

(*Continued on page* 52)

Spectra of Simple Glasses in the Infrared Range and their Relations to the Structure of Glass

By V. A. FLORINSKAYA and R. S. PECHENKINA
Free Translation of the Russian Original Text
By WILHELM EITEL, Institute of Silicate Research
University of Toledo, Toledo, Ohio

PART I

Under the auspices of the Academy of Science of the U.S.S.R., and by invitation of the institute of Silicate Chemistry of this Academy, the State Optical Institute, and the Leningrad Section of the All-Union Society of Silicate Technological Research, a most remarkable symposium was organized in Leningrad in November 1953 under the title "Structure of Glass". The representative volume of the proceedings of this symposium, published in 1955* contains many papers of high interest for international glass investigation. Among these we have chosen as one of the most important contributions is the present investigation series on the infrared characteristics of simple glasses for their constitution and structure. The first section concerns the pure silica glass, and the crystalline modifications of silica, the second the lead silicate, the third the sodium silicate glasses; these will appear in consecutive issues of this publication.

The publications of the Russian authors have a very high rank of accuracy and conclusiveness and should therefore be made known through this translation to American glass research scientists and technologists as completely as possible. The restricted space of the present paper, however, impedes the publication of a literal translation of the entire text. Therefore, only the experimental sections are given here in extenso, with the original figures.

THE STRUCTURE OF FUSED SILICA

• How is a glass represented in the data of infrared? Does it appear as a homogeneous structure, or is it a combination of different structures? Which is the arrangement of the tetrahedra and of the metal cations in the glass? Does it appear as a totally random unit, or do some regular groupings of atoms exist in the glass? Do the [SiO_4] tetrahedra units possess inter-atomic distances which are invariable, or are these variable if the composition of the glass is changed?

Let us consider the simplest glass, fused quartz.** Some conclusions on its structure may be derived from a comparison of the spectra of silica glass with those of the different modifications of silica, and also by a comparison of the spectra of silica glasses of different manufacturing methods. In Fig. 1 are the results of measurements with the Beckman spectrophotometer, based on transmission spectra from thin layers of powders of the different modifications of silica. The layers were applied on a support of sylvite; they had a thickness of about 1 μ. The wavelengths (λ) are plotted as the abscissae, the transmission (τ) of the sample (in percent) as the ordinates. The curves, a, b, v, g, correspond to silica glass (fused quartz) obtained from the Heraeus Company, the low-temperature modifications of cristobalite, quartz, and tridymite, respectively. Tridymite and cristobalite were kindly prepared by the senior scientist of the Institute of Silicate Chemistry, V. G. Voano, and checked by crystallographic and electron diffraction methods.

For all of the modifications of crystallized silica and for silica glass, a strong absorption band is observed at 9 μ and in the range from 12 to 13 μ. For crystal quartz the first band is a doublet, and the principal minimum of transmission is 9.15 μ. For cristobalite it is also a doublet, but it is somewhat displaced to shorter wave lengths relative to that of quartz. Its principal minimum of transmission is at 9.10 μ. For tridymite the band has the shortest waved position (minimum at 9.04 μ).

The second band, which is separately designed in Fig. 2, has for cristobalite and tridymite only one transmission minimum at 12.61 and 12.70 μ respectively, while for quartz there are two minima at 12.55 and 12.85 μ. The quartz lattice has a strong dichroism in the infrared range. For the ordinary light the maximum of reflection is observed at 12.53 μ, for the extraordinary light at 12.85 μ. This dichroism of the quartz structure also appears in the transmission spectrum of quartz powder.

By a comparison of the curves b, v and g (Fig. 1) it is concluded that the distinctions of the structure of the SiO_2 modifications are sharply developed in their spectra.

Both bands of fused quartz, relative to the corresponding bands of the crystallized modifications, are considerably broadened, show lower intensity, and the secondary minimum in the first band is absent. It is, however, characteristic that the minima of transmission for both bands coincide in their wave lengths with the corresponding minima of crystallized quartz.

A comparison of the spectra of silica glass of different manufacturing demonstrated that they are rather similar, but not identical in all details. The structure of fused

* A short review with a list of the contents is given in *Ceramic Abstracts*, August 1956, p. 164.

** The identity of "fused quartz" with industrial silica glass is obvious. Therefore, to avoid any confusion of "quartz" as the crystal phase, and "quartz" as fused quartz we want to use in the following text exclusively for the latter product the general term "silica glass", omitting its most common but not self-evident origin from quartz as its natural raw material.

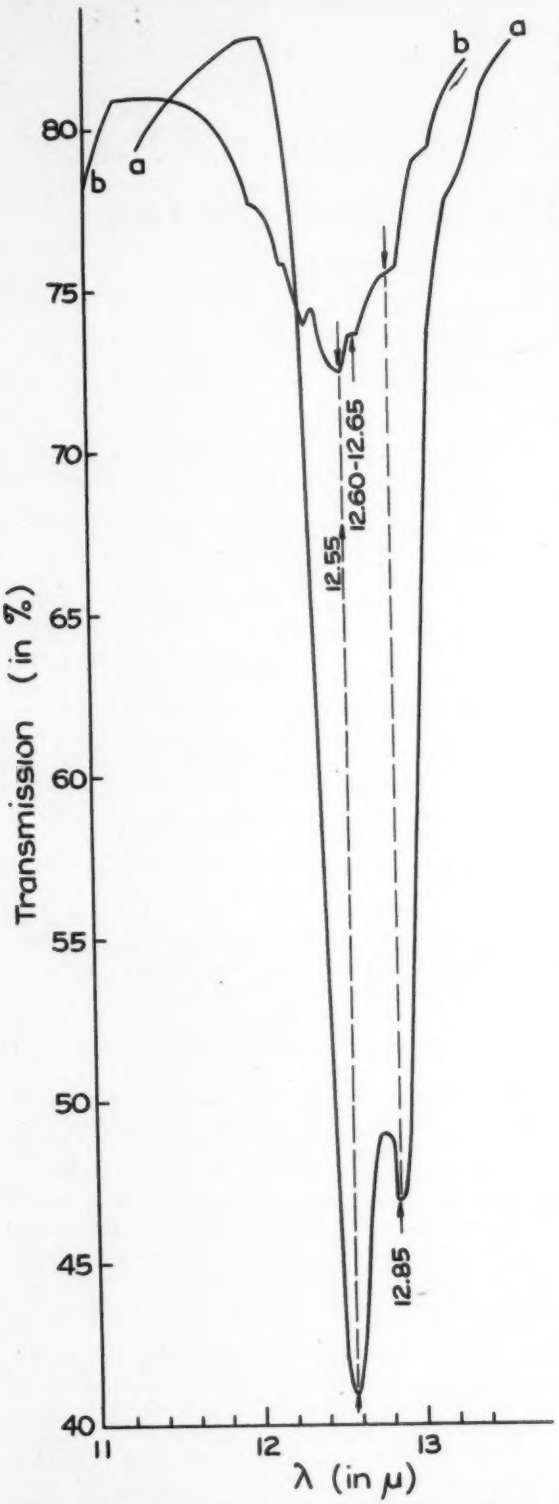

Fig. 1. Transmission spectra of different modifications of silica in the range from 6.5 to 13.5 μ (after data of the authors and N. A. Sevchenko.) a—a thin layer of silica glass from Heraeus; b—the same, of cristobalite; v—the same, of quartz; g—the same, of tridymite; d—the same, of amorphous silicic acid; e—of a thin blown film of silica glass from Heraeus, showing interference colors; zh—a thicker film blown from industrial silica glass.

quartz exhibits a complex and heterogeneous character even though it represents the simplest type of glass. This complexity is determined by a series of reasons.

One of the first reasons is evidently the fact that even at the fusion temperatures of quartz the viscosity of the melt is still very high, and therefore the solid framework of the quartz is not broken down entirely. Zones of still regular distributions of the atoms remain in a fine-dispersed state similar to their previous distribution in the quartz framework. This means that crystallites of variable dimensions, and in different degrees of distortion of the lattice structure still occur. A series of facts convince us of the following:

1. Brügel[8] demonstrated in his investigations that in the reflection spectrum of fused quartz of Heraeus the first fundamental band reflection (9 μ) is not only very close to the position of the principal maximum of the crystallized quartz (8.93 μ) but also that the fine structure which is so specific for the framework structure of crystallized quartz is also preserved.

2. The intensity of this reflection band, in the maximum at 9 μ, is unusually high. The reflection coefficient for crystallized quartz is about 90 per cent in this range, for a glass with a very high content in silica it is about 35 to 30 per cent, but for silica glass it is, according to the data of several investigators, about 65 to 72 per cent, i.e. anomalously high. This fact is evidently related to the presence of zones having a regular distribution of the atoms in the glass.

3. The spectra of silica glass, fused at different temperatures above 1713°, i.e. above the fusion temperature of quartz (1680°) and cristobalite (1713°), make evident the great difficulty by which the quartz framework is destroyed.

Fig. 3 shows the transmission spectra for powders of silica glass in the wave length range from 12 to 13 μ, which is particularly sensitive for the structure of the frameworks. Samples of fused quartz were kindly furnished by N. F. Orlov at the laboratory of Professor V. V. Vargin. The investigation was made by N. A. Sevchenko and V. A. Florenskaya. The measurement of the transmission with the same specimens was twice repeated on the Beckman spectrophotometer and the instrument IKS-23 with automatic recordings.

The curves a, b, v, g, d, are spectra of Brazilian quartz and glasses prepared by fusion of the same quartz in a Tammann furnace at 1720°-1740°, 1750°-1800°, 1850°, and 1900° C., respectively. The accuracy of the determination of the temperatures was 25°; this error may only be to lower the measured temperatures. The glass melt was kept at constant temperatures for 30 to 40 minutes. A powder was prepared after the fusion of the crystallized quartz at a temperature of 1720° to 1740° and subsequent cooling; in all the other cases the material was silica glass.

Curve b demonstrates that the principal substance of the powder was nothing but crystallized quartz because the band at 12 to 13 μ has still a great intensity and the doublet with a minimum of transmission at 12.55 and 12.85 μ is exclusively characteristic for the framework structure of ∝-quartz.

Curve v has the characteristic doublet as before, although the minimum at 12.85 μ is markedly leveled, and the band is broadened in comparison with the pre-

ceding case. The doublet type of curve b which is correlated with the dichroism of the quartz structure, and the preservation of the accurate position of both minima for ∝-quartz indicates the presence of the quartz-framework also in this case.

Curve g shows that after an exposure of the melt at 1850° the intensity of the band is much weakened, the half-width value became greater, and a more complex structure is developed. However, also in this case, the principal minimum of the band lies at 12.55 μ (as in ∝-quartz), and even the distinct minimum is observed also at 12.85 μ, i.e., there are in this case still residues of the quartz framework.

Beyond that, a prolongated exposure of the melt at high temperatures evidently brings about the formation of cristobalite as this is indicated by the appearance of the characteristic frequency at 12.60 to 12.65 μ, as well as by the splitting up of the band at 9 μ to two minima.

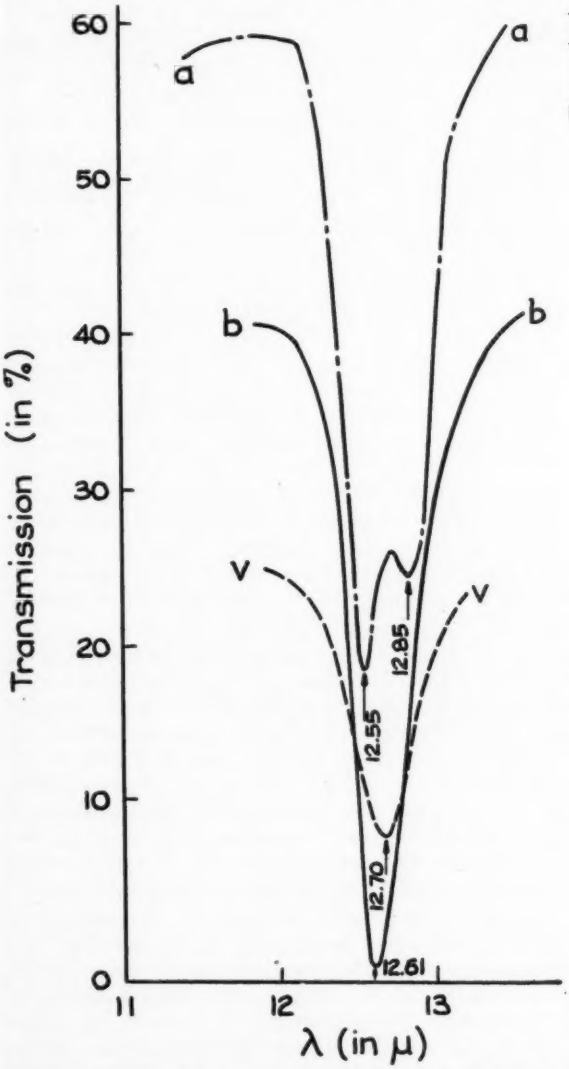

Fig. 2. Transmission spectra of different modifications of silica in the range from 12 to 13 μ. a—a thin layer of quartz powder; b—the same, of cristobalite; v—the same, of tridymite.

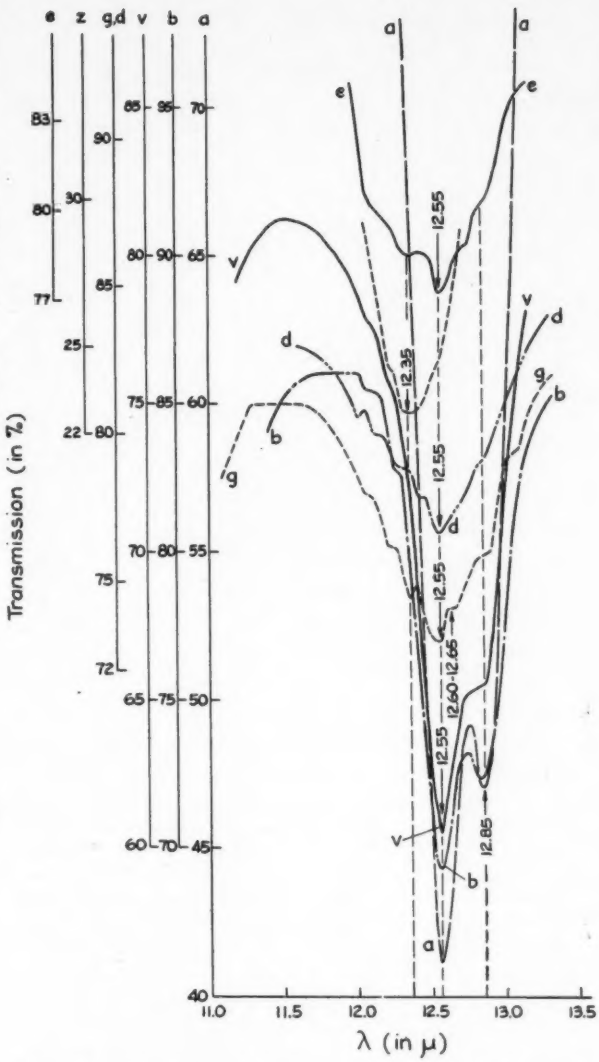

Fig. 3. Transmission spectra of quartz and silica glass of different manufacturing in the range from 11 to 13.5 μ. a—thin layer of Brazilian quartz powder; b—the same, of silica glass produced at 1720° to 1740°; v—the same, prepared at 1750° to 1800°; g—the same, prepared at 1850°; d—the same, prepared at 1900°; e—the same, of silica glass of Heraeus; zh—a thin film blown from silica glass of Heraeus.

In Fig. 4 are separately shown the transmission curves of layers of the powders of quartz and silica glass in equal thickness; the latter was molten and kept at 1850°. This design makes possible a direct comparison of the intensities of the bands in the two cases mentioned, and shows graphically that, as a long distance order in the position of the atoms is destroyed, the intensity of the band is distinctly decreased, i.e., that there is a specificity in the regular structure of silica.

Curve d (see Fig. 3) which corresponds to the temperature 1900° makes evident that in this case only one minimum at 12.55 μ remains, besides some nearly imperceptible traces of the minimum at 12.8 μ.

The preservation of the accurate position of the transmission minimum at 12.55 μ as in ∝-quartz, indicates

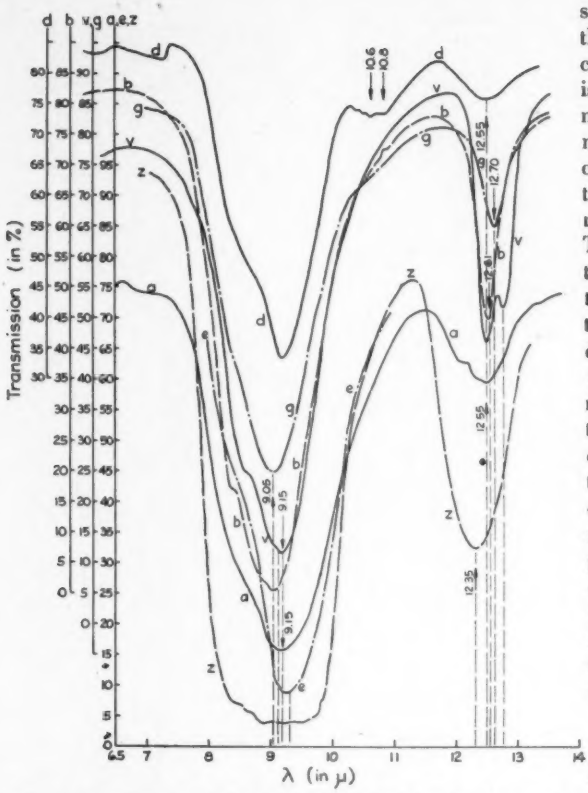

Fig. 4. Comparison of the transmission spectra in the range from 11 to 13 μ for layers of powders of Brazilian quartz (a), and silica glass produced at 1850°C. (b); the thickness of the layers is the same for both samples.

that in this case crystallites of quartz are present but the zones with regular positions of the atoms are considerably smaller than those in the previous cases in which also the minimum at 12.85 μ was preserved.

Curve e concerns the layer of silica glass powder of Heraeus. The transmission minimum of the layer lies at 12.55 μ, i.e., again as in α-quartz. In the other samples of silica glass from the same firm, one sometimes can observe with different degrees of distinction traces of the minima at 12.8 and 12.60 to 12.65 μ.

Curve zh corresponds to a thin film prepared from the same glass to which the curve e is coordinated.

After a second careful fusion which brings about an additional distortion of the framework structure, the transmission of silica glass is shifted to 12.35 μ, i.e., by 0.2 μ to the side of shorter wave lengths in relation to all the previous cases. This shift, which is only determined by differences in the technology of the manufacturing of silica glass, is even larger than the shifts of the same band determined by the differences in the crystal frameworks (12.55 μ for quartz, 12.61 μ for cristobalite, 12.70 μ for tridymite), and again is emphasized that in all previous cases the regular framework was not completely destroyed and that the possibility still exists of an additional distortion.

The preceding series of curves altogether shows that the destruction of the quartz framework takes place with much difficulty even after a prolonged exposure of the melt at very high temperatures.

The existence of polymorphic inversions in crystallized silica is given as a second reason for the complexity of the structure of silica glass. The inversion of one modification into another one requires a determined time which is the longer the lower the temperature. These inversions may be strongly accelerated by the presence of different mineralizing agents. Every initial crystalline quartz is contaminated by different kinds of additions or impurities, which, under given technological conditions, act as mineralizers for one or the other framework structure. Therefore, if in silica glass quartz crystallites still exist, then some admixtures of crystallites of other modifications must also be present. The latter may arise from two sources, viz., either from quartz crystallites, or directly from the melt in which cybotactic groups exist (i.e. quasicrystalline aggregates) and act as adequate mineralizers. The amount and the type of the lattice structures of the crystallites of the different modifications are determined by the whole technological process, i.e. by the temperature of the melt, the time period of exposure of the melt at a constant temperature, the time period of maintaining the ready-made quartz block at those temperature intervals in which the polymorphic inversions occur (the "annealing"), and by the contamination of the quartz raw material. How great the role of the contamination in the formation of the structure of silica may become is demonstrated by the work of Kaĭnarskiĭ and Degtyareva[9], Bailey[10], Birks and Schulman[11].

Kaĭnarskiĭ and Degtyareva showed that the addition of 1.5 per cent of admixtures into a quartz melt and subsequent exposure to 1400° of the resulting silica glass for 6 hours converts it to tridymite, or to cristobalite, as a function of the nature of the contamination.

Birks and Schulman established that calcination of amorphous silicic acid at 1200° for a short time in the presence of carbonates of magnesium, calcium, strontium, baryum or manganese brings about a conversion to crystalline quartz, although quartz is thoroughly metastable in this temperature range. The contamination by other mineralizing agents brings about inversion to cristobalite under these conditions. One may therefore imagine that the impurities in the initial quartz may greatly determine equally the microstructure of ensuing silica glass and its further history.

A third reason for the complex structure of the glass is the presence of groups Si-O-H in it. The kinds of bonds and the structural groupings of such a nature are evidently quite diverse. There are also groups which produce absorption bands in the long-waved part of the spectrum. In Fig. 5, curve "a" shows the transmission of a layer of amorphous silicic acid which loses 20 per cent water by calcination, according to the analysis. Before the calcination there is an intense band with a minimum at 10.6 and 10.8 μ in the transmission spectrum.

Curve b shows the transmission of the same silicic acid after calcination at 1200° for some hours. The band disappeared, leaving only weak traces; by curves v and g are represented, for comparison, the transmissions of films of silica glass without the bands in this range but with a band which has its minimum at 10.8 μ. In the transmission curve of the powder of crystallized quartz such bands are absent, but they appear immediately if very fine powder of quartz with a grain size of 1 μ is for some time brought in contact with water. Water itself

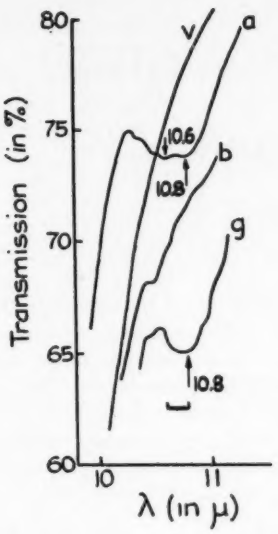

Fig. 5. Transmission curves of amorphous silica in the range from 10 to 11 μ. a—a thin layer of the powder of not calcined silicic acid; b—the same, from calcined silicic acid; v, g—films of silica glass.

also has no absorption band in this range. All this makes evident that the band at 10.8 μ which is sometimes observed in silica glasses belongs to the group Si-O-H.

There are also other forms of the bonds Si-O-H which only appear in the range near 3 μ. Physicists often observed a strong difference near 3μ in the spectra of fused and crystalline quartz. Crystallized quartz has a wide band of absorption with a complex fine structure; the maximum of absorption lies at 2.95 μ. For fused silica glass this band is distinct and narrow; its maximum is usually observed at about 2.75 μ. Some investigators interpreted it as an overtone of the fundamental frequency.

A comparison of the transmission spectra of silica glass prepared at different temperatures, and also of silica glass of different origin demonstrated that this band is varied in its intensity as a function of the technological conditions, and may be varied between 2.85 and 2.68 μ, i.e., from the frequencies of the hydroxyl groups in the associated state to the frequencies in monomeric water, but sometimes the band may be entirely absent (cf. data of Florenskaya and Sevchenko). This shows that the band cannot be an overtone of the fundamental frequency, for it may be removed by a normal technological process. Hower, because in the overwhelming majority of silica glasses, this band is intense, the role of the groups Si-O-H in the glass cannot be negligible.

As a fourth reason for the complex structure of silica glass there are local strains which inevitably must arise from heterogeneities in the glass structure. Such a strain effect in addition will change the position of the atoms in neighboring portions.

The comparison of a great number of spectra of silica glasses whose preceding technological history was different has demonstrated further that there are many finer details in the spectra of some specimen which are absent in the spectra of others, and vice-versa. The structural differences, which for the time being remain entirely obscure, disappear behind all these details.

Our conclusions may deviate somewhat from those arrived at by other investigators who worked on the basis of X-ray structure analysis [12], [13], and [14]. The latter emphasize that in silica glass only crystallites of crystobalite are detected. From our viewpoint there may be, of course, cases in which, by the special nature of the entire technological process altogether (the role of annealing is in this respect particularly important), that cristobalite is much more strongly developed than all the other modifications. Based on investigations of a great number of the most diversified materials, however, we are not able to agree that for real silica glasses the structure of the cristobalite type is exclusively characteristic.

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A. SILVERMAN IS NAMED BLEININGER AWARD MEDALIST

Dr. Alexander Silverman, professor emeritus of chemistry, University of Pittsburgh, has been chosen to receive the 1958 Albert Victor Bleininger Award. The announcement of Dr. Silverman's selection for the award was made at the December 6th meeting of the Pittsburgh Section, American Ceramic Society by C. Burton Clark, chairman. Presentation of the medal and scroll, symbolizing the award, will be made at the Eleventh Annual Award Dinner to be held March 14th, 1958 in the Terrace Room of the Penn-Sheraton Hotel, Pittsburgh, Pa.

The Bleininger Award, one of the highest honors for achievement in ceramics, has been given each year since 1948 by the Pittsburgh Section of the American Ceramic Society.

An international authority on the chemistry of glass, author of over 200 publications, and holder of 32 patents, Dr. Silverman has been associated with the University of Pittsburgh since 1905. From 1915 to 1951 he was head of the Chemistry Department and since that date has been professor emeritus of chemistry. Dr. Silverman is a Fellow of the American Ceramic Society, Institute of Ceramic Engineers, The American Association for the Advancement of Society, Society of Glass Technology (England), and is a member of the American Chemical Society, Deutsche Glastechnische Gesellshaft, Sigma Xi, and many other societies. He also has served as vice president from 1950 to 1955, and as president in 1955 of the Commission on Inorganic Nomenclature, International Union of Pure and Applied Chemistry.

His keen interest in glass since his first employment with MacBeth-Evans Glass Company in 1902 is typified by the presentation of his half century collection of modern glass to Alfred University in 1951.

A resident of Pittsburgh since his birth in 1881, he resides at 1514 Denniston Avenue.

Eighteenth Conference on Glass Problems at Urbana

• NEITHER FOG, NOR SNOW, nor ice prevented the gathering of approximately 250 glass technologists at the Illini Union Building, University of Illinois on December 5 and 6 for the Eighteenth Conference on Glass Problems. The conference was sponsored jointly by the Department of Ceramic Engineering at the University of Illinois and the Ohio State University, with the principal subjects of interest being Raw Materials, Methods of Glass Melting, and Instrumentation of Glass Furnaces.

The first session, devoted to raw materials, was under the chairmanship of J. P. Poole, Brockway Glass Company, Brockway, Pennsylvania. Dr. Poole introduced Ross J. Martin, Associate Director of the Engineering Experiment Station, University of Illinois, College of Engineering, who pointed out that engineering enrollment has reached the high equivalent of that attained just after World War II and that greater emphasis should now be put on the quality of the prospective engineering students rather than the quantity.

He stressed the importance of ceramics to the all-important future satellite programs and emphasized that future research would probably involve a program of basic effort designed to know in advance the reason "why" things happen rather than "know how."

The first paper, "The Use of Sulfates in Glass Manufacture", by W. H. Manring and R. W. Hopkins, Glass Technicians, Inc., Hamilton, Ohio, was presented by Mr. Manring.

One of the main functions of sulfates in a glass batch is to control scum formation in the furnace during the melting process. The other major function of sulfates is to promote more rapid fining of the glass and to control oxidation-reduction influences. Where glass fining problems stop and oxidation-reduction problems begin cannot be defined. In most cases glass fining is dependent upon the state of oxidation of sulfur.

An empirical approach to evaluating oxidation-reduction influences was made. In order to simplify the task of determining optimum quantities of sulfate in a glass batch, this work relies on mathematics to establish a yardstick or measuring device. Oxidized glasses will carry plus values whereas reduced glasses will show as minus quantities. Under this type of system an oxidized glass will normally have a range of –1.0 to +15.0, amber glass will have a range of –15.0 to –40.0 and emerald green glasses will range from –12.0 to +2.0, depending upon the furnace atmosphere.

This approach involves assigning values for oxidants such as salt cake (Na_2SO_4), gypsum ($CaSO_4\ 2H_2O$), and barytes ($BaSO_4$)—in terms of carbon as the standard. By definition, 1 ounce of carbon per 2000 pound sand batch has a reducing value of –1.0. The bases for assigning these values are both practical experience and written equations similar to the following:

$3\ Na_2SO_4 + CaS = 3\ Na_2O + CaO + 4SO_2$
6 lb. salt cake = 1 lb. calcium sulfide.

$3\ CaSO_4{\cdot}2H_2O + CaS = 4\ CaO + 2H_2O + 4SO_2$
7.2 lb. gypsum = 1 lb. calcium sulfide.

$3\ BaSO_4 + CaS = 3BaO + CaO = 4SO_2$
10.0 lb. barytes = 1 lb. calcium sulfide.

Incidentally, these equations illustrate the relative values of these various sulfates in so far as oxidation-reduction problems are concerned. The values assigned to various batch ingredients follow:

Oxidation-Reduction Chart
All values in terms of ozs. of carbon per 2000 lb. sand batch

Oxidizing		Reducing	
1 lb. Sodium Sulfate (Na_2SO_4)	= +0.67	1 lb. carbon (c)	= –16.0
1 lb. Gypsum ($CaSO_4{\cdot}2H_2O$)	= +0.56	1 lb. Sulfur (S)	= – 6.4
1 lb. Barytes ($BaSO_4$)	= +0.40	1 lb. Calcium Sulfide (CaS)	= – 4.0
1 lb. Nitre ($NaNO_3$)	= +0.32	1 lb. Ferrous Sulfide (FeS)	= – 3.3
		1 lb. Iron Pyrites (FeS_2)	= – 3.5
		1 lb. Iron Chromite ($FeCrO_3$)	= – 1.0
24 lb. salt cake = 1 lb. carbon		24 x .67 = 16.0	
28½ lb. gypsum = 1 lb. carbon		28½ x .56 = 16.0	
40 lb. barytes = 1 lb. carbon		40 x .40 = 16.0	
50 lb. nitre = 1 lb. carbon		50 x .32 = 16.0	

An approach of this type cannot be exact because factors in some instances can be obtained only through practical experience. The basic equation involved is the reaction between salt cake and carbon and is strictly theoretical. Nitre, for example, loses its oxygen so rapidly that full theoretical value cannot be utilized, the loss taking place before sulfur is oxidized. Another factor which at first glance appears to be in error is the one for iron pyrites. Experience with iron pyrites as a colorant indicates that in a properly stabilized amber its influence is almost identical with ferrous sulfide. Apparently in normal oxidizing furnace atmospheres, iron pyrites loses one molecule of sulfur at very low temperatures and at a very rapid rate, becoming in effect FeS for all practical purposes. Furnace atmosphere, always an important influence, is modified to fit the melting unit in question. Arsenic is conspicuous in its absence from the table, largely because it first is a reducing agent, later an oxidizing agent, and is normally used in conjunction with nitre.

The next paper presented was "Fluorspar for The Glass Industry", Robert C. Keaney, St. Lawrence Fluorspar,

Inc., Pittsburgh, Pennsylvania.

Fluorspar, a crystalline mineral, is the chief source of fluorine. Natural cryolite is higher in fluorine content, but the total supply is small.

There are two chief sources of fluorspar: (1) in limestones where the chief impurities are calcium carbonate, barite, and sulphites; and (2) in siliceous rocks, such as granites, where the SiO_2 content is high.

The St. Lawrence Fluorspar Corporation has mines and processing plants in Newfoundland and Mexico, with additional processing plants in Wilmington, Delaware, and Cleveland, Ohio. The Newfoundland and Mexican operations comprise what are said to be the largest individually controlled fluorspar reserves in the world, containing reserves in excess of six million tons. In Newfoundland, fluorspar deposits are found in the host rock of granites, whereas in the Mexican operations the host rock is generally limestone.

At Wilmington, Delaware, there is a large flotation-type plant which was built to produce 50,000 tons of acid grade fluorspar per year. This production is based on a mill feed of 300 tons of Newfoundland crude spar per day. The ore is run into a gyratory primary crusher, which crushes the material to one inch fragments before it is fed to a 9 x 9 ball mill, where it is further crushed by steel balls. The crushed spar is then run to the flotation plant where various reagents are added to separate the impurities from the fluorspar. Reagents are added not only to float fluorspar but to depress the gangue minerals. In this operation, actually the majority of the floated product is fluorspar.

One of the advantages of maintaining good flotation plants at ports in the United States: it is quite possible to import fluorspar from Newfoundland, Italy, Spain, Mexico, Germany, and other producers either in the concentrate or crude mill feed form. With a flotation plant, the finished analysis of this product can be carefully controlled regardless of the source.

Since 1952, imports have exceeded domestic production and are pulling away fast from the production in this country. In 1952 there were produced 331,000 tons in this country, while 352,000 tons were imported. In 1956 domestic production was 329,000 tons while imports increased to 485,000 tons. In the first quarter of 1957, imports increased 11 per cent over the same period in 1956 and are now running approximately two tons of imported fluorspar for every one ton produced domestically.

The next paper was "Problems in Sampling and Screen Testing Raw Materials", Paul Close, Owens-Illinois Glass Company, Technical Center, Toledo, Ohio.

Mr. Close's useful and practical paper was concerned with the principles involved in sampling and screening raw materials.

The primary reasons for screening are: 1) to match materials; 2) to determine coarse and fine particles; to avoid batch carry-over, clogging, checkers, etc.; 3) to control quality.

Screen testing equipment is estimated at $800 to $900 per installation, a small cost compared with that of 100,000 lb. of glass.

It is axiomatic that sampling should represent the bulk as accurately as possible.

A system was proposed indicating sampling points from a car load of raw materials. It can be worked out statistically, with the aid of certain A.S.T.M. specifications. However, the important consideration is to work out a practical plan that proves to give satisfactory and duplicable results. Sampling tubes have proven to be useful. One procedure is to take a "grab" sample in stated locations and accumulate about 15 lb. total sample. Other samplers use a "sample thief", made in tube form, in which the tube is projected into bulk material, with later withdrawal producing the sample. Usually, bulk samples are 15-30 lbs. of material from which the actual sample should be reduced to 100-200 gm. by splitting.

Screens are often abused but should be kept clean, brushed frequently (washed less often), and watched for clogging. Brushings between each test with a reduced paint brush are recommended. It is not advisable to attempt soldered screen repairs.

Screen standardization (based on 100 gm. sample of standard beads obtainable from the Bureau of Standards) can be accomplished as follows: 1) measurement with aid of microscope; 2) matching against calibrated set; 3) comparison with new sieves; 4) standardization with calibrated glass beads.

Results of tests with three sets of screens (20-40 mesh) were given; one of them involving glass beads is a newer test and may become more useful as more accurate beads are available. The maximum per cent variation with the various sets was about 2.9 per cent. Practically, the use of calibrated screens is questionable.

Problems of test procedures were also discussed. Ten to fifteen minutes is practical time of vibration. Friability of materials varies considerably. Burnt dolomite tends to ball-up into small sizes, and wet screening may have to be used. The paper was concluded with a discussion of recent work by A.S.T.M. Committee C-14.

The Thursday afternoon session, devoted to methods of glass melting, was under the chairmanship of Roy S. Arrandale, Thatcher Glass Manufacturing Company, Elmira, New York.

The first paper was "All-Electric Furnace Operation", Allen J. Erickson, Northwestern Glass Company, Seattle, Washington.

All-electric melting of container glass has been practiced for a number of years, but relatively little has been published about the furnace construction, operation, and economics of this type of melting process. The items of interest are the melting rates, furnace life, and glass quality together with the refractory repair costs and energy consumption per ton of glass produced. The purpose of the paper was to give facts based on a specific type of all-electric furnace which the Northwestern Glass Company is using together with a few of the interesting operating details.

The unit resembles a conventional regenerative furnace with the superstructure removed (from a point 8 inches above the metal line) along with the ports and regenerators. Then a batch blanket 12 to 18 inches in thickness is laid over the entire melting surface, and electrical energy is introduced to the glass batch by the use of molybdenum electrodes inserted through the sidewalls. The batch blanket is continuously fed as the melting process goes on and the glass passes through a conventional floor level throat into a small refiner or extension to the forehearth, where a firing chamber is provided

so that surface heat can be applied if necessary.

The following economic features of this type of melting are based on a 30-month campaign and a daily rate of pull of 30 tons per day. This 30 tons per day was the daily average pull per operating day for the 30-month period, which gave a total of 26,300 tons melted or 120 tons per sq. ft. of melting area per campaign. The glass melted was amber, with the batch containing 10 per cent cullet.

1. Furnace and feeder repair costs were $0.89 per ton pulled, divided among the following items: (a) all refractories and mortars; (b) all factory labor for draining the tank, wrecking the furnace and feeder, servicing the masons, cleanup, and warm up; (c) all mason labor; (d) all minor supplies and tools; (e) all molybdenum electrodes used during the 30-month campaign. The $0.89 does not include the warm-up fuel nor does it include the factory burden while the furnace is down for its 13-day repair period.
2. Energy consumption was 1000 kwh per ton pulled, and at 3.7 mills per kwh amounted to $3.70 per ton pulled.
3. Repair plus fuel costs were $4.59 per ton pulled. If a comparison of this figure is made with that of a three to five shop regenerative furnace whose repair costs are $1.50 per ton pulled and whose average fuel rate is 7000 cu. ft. of natural gas per ton pulled at $0.39 a 1000 cu. ft. or a fuel cost of $2.73 per ton pulled resulting in a repair plus fuel cost of $4.23 per ton pulled, then the trade is paying a premium of $0.36 per ton pulled to melt all-electrically. However, because the two all-electric furnaces are primarily amber production units, and because the loss in production efficiency owing to stones is so low, the author feels that the all-electric melting results in a 1 per cent gain in production efficiency plus intangible gains from excellent homogeneity. The value of these increases in production efficiency counteracts the $0.36 per ton premium.

At present, the output of the units is being boosted with a natural gas direct-firing system. The all-electric units can produce only a maximum of 32 tons a day, which was sufficient for most of the jobs that were run on a Hartford-Empire 5-section I. S. machine. However, with the coming of the 6-section machine which at times needs 42 to 45 tons per day it was decided temporarily to direct fire the furnaces to get those extra tons rather than to enlarge the melting areas and install more transformer capacity. The reasons for this were (1) transformers were not available in time for the first 6-section unit, and (2) it was not certain that an enlarged all-electric unit would produce all the extra tons that were needed.

All-electric melting of container glass, even in its present state of development, in areas of low-cost electric-power, compares well with conventional melting methods.

The next paper was given by A. K. Lyle, Emhart Manufacturing Company, Hartford-Empire Company Division, Hartford, Connecticut, and entitled, "Unit Melter-Advantages and Applications."

The need for a small melting unit providing a capacity of 20 to 50 tons per day brought about the development of the present-day unit melter. The unit-melter is a direct-fired, continuous, glass-melting furnace quite similar to an extended forehearth. The furnace thus becomes a long narrow section of a conventional side-port furnace yet preserving similar temperature distribution.

Several recent improvements in design include provision for increase in depth of glass in the tank from 20 to 26 inches, thus providing the maintenance of higher temperatures in the dog house and better circulation and fining of the glass. Higher temperatures in the dog house are desirable and necessary for the successful operation of the "infolding feeder" which infolds or surrounds each charge of raw batch with molten glass. This type of feeder has proven to be most successful for this type of furnace. The many structural features were shown by means of numerous slides indicating the versatility of these units.

There are now 35 unit melters in operation and with completion of melters now on order and under construction there will soon be a total of 50 in operation. A new larger size melter, 10 feet x 40 feet in melting area, has recently been built to produce 55-60 tons per day.

The unit melter offers many advantages such as low investment cost as well as low maintenance cost. It provides high quality glass and great versatility of operation such as change from lead to barium glass or flint to colored glasses, etc. It is an ideal extra furnace, adaptable to custom melting and readily changeable operations. It offers a wide choice of fuels, and electric boosting has been applied with success. The average fuel economy is equivalent to slightly less than 12,000 cubic feet of natural gas per ton or a little less than 80 gallons of oil per ton. The average production is 87 per cent of rated capacity.

The unit melter has been in operation only a short time, but the generally satisfactory results obtained indicate that it can become an important part of the production of glass for containers and other items.

The next paper given was "Side Port Furnaces", Fred M. Merritt, Toledo Engineering Company, Inc., Toledo, Ohio.

The side port furnace occupies a place in the glass industry for the most economical production of large volumes of glass. Its application to the industry is varied, covering the production of pressed and blown ware, tubing, drawn sheet, rolled plate, and other glasses. Furnaces for such glasses range in size from approximately 300 square feet to as much as 2500 square feet of melting area.

When the area of the melter required for the volume of production becomes large, side firing is the most feasible means available to provide the proper distribution of heat release down the length of the furnace hearth. With the advent of the metallic recuperator, which overcomes many of the problems experienced with refractory type installations, furnaces of small and medium areas can now be fired from the side to obtain a controlled heat release distribution in an economical manner. These applications are reasonable on furnaces which would require as much as 50,000 CFH of 1000 BTU natural gas when operated as a direct-fired unit.

Side port fired regenerative furnaces fill the requirement of controlled distribution with the greatest gain in heat recovery. This gain in turn reduces the fuel cost of glass production. The expenditures involved in these furnaces confront the designer with the requirement of

effecting maximum heat transfer to the glass and high waste heat recovery within economic limits.

Any approach to fuel application must be preceded by the determination of the amount of fuel required and the type of fuel to be burned. This determination is based upon the type of glass to be made and the furnace conditions required. These conditions dictate the amount of heat required for holding heat or "idle load" while the glass to be produced determines the "glass load."

The greatest percentage of fuel requirement, within the operation, is that necessary for "idle load" to maintain the operating temperature. This idle load is a function of the combination of the furnace temperature, refractory structure, age of the furnace, fuel thermal efficiency and size of melting area.

The major economic limitation placed upon industry is in obtaining maximum heat recovery through regeneration. The cost of additional checkers is not only found in the refractories and labor, but in the initial costs of building space, excavations, and foundations. Therefore, checker volumes beyond a definable point do not justify their cost in view of the heat recovery remaining at low temperature differentials.

In conventionally designed side port furnaces, it has been found that approximately 14 to 17 feet of checker height is a practical consideration based on furnace load and operating conditions.

This depth of checkers must be balanced by the fuel savings and operating conditions obtained in view of the expenditure necessary for such a regenerative installation. To obtain these depths without resorting to deepening the basement at resultant high building costs, the box type of regenerator construction is recommended. With this arrangement, checkers can be carried to within two feet of the top of tank blocks. This construction provides additional advantages through manifolding the exiting gases and the entering combustion air at the port necks. Handling the waste gases in such a manifold instead of uptake ducts decreases refractory wear and results in decreased replacement cost. The box type regenerator construction results in increased initial furnace cost but normally repays this difference at the first cold repair.

In order to obtain the desired flame characteristics for the particular application, the following adjustments can be made to certain variables according to desired results:

1. An increase in combustion air preheat temperature results in an increase of the temperature of the flame.
2. An increase in the quantity of combustion air over the actual requirements results in a lower flame temperature.
3. Primary air premixed with fuel gas increases the flame temperatures near the center of its length and reduces the end temperature.
4. An increase in the firing rate of fuel gas or oil without increasing premixing air or atomization medium will increase the emissivity of the flame. This increase may be accompanied with a decrease in flame temperature effecting lower heat transfer which may be more than heat transfer gain through emissivity change.
5. The use of steam as an atomizing medium for oil reduces the temperature of the flame along its entire length.
6. Flame temperature is higher at the burner when air is used in place of steam as the oil atomizing medium. The tail of the flame has a higher temperature where steam is used than when air is used.
7. An increase in the rate of the atomizing medium will increase the flame temperature midway in its length, thus reducing the tail end temperature.

"Performance Data on End Port Regenerator Furnaces", Henry Moore, Metro Glass Company, Jersey City, New Jersey, was the next paper presented.

The data presented concerned the operation of a relatively small end port furnace over a four year period. However, the data are representative of four other operating units. This particular furnace is 23 feet long by 13 feet wide, equal to a melting area of 299 square feet. Amber container glass of good commercial quality in respect to homogeneity, seed, and blister ratings was produced over the entire campaign. Similar results are being obtained with several other end ports of larger size, the largest being 20 feet wide by 32 feet long or 640 square feet with plans for still larger dimensions under consideration.

Although all end port furnaces are similar in basic design, there are important differences in the application of fuel, methods of charging batch, and relationships in size and design among melter area, regenerator volume, port area, flues, and chimney. Any one or a combination of these factors can mean the difference between an efficient or inefficient furnace or the difference in the production of good or poor quality glass.

A typical end port furnace was illustrated. This furnace is fired over the ports using natural gas, heavy or light oil fuels. (In other end port designs, fuel is introduced through burners mounted under the ports or in the port necks.) Multiple or single burners are used, depending on the size of the furnace and type of burner. Most operators prefer over-the-port-firing which provides more efficient mixing of fuel and combustion air. In addition, the flame is directed toward the glass rather than at the bridgewall which is somewhat less destructive on the shadow wall than are the other methods of firing. Burners located over the ports are more convenient for servicing and adjusting in that this area can be made more comfortable for working than that under or between the ports.

The dog house and batch charger necessarily are located on the side of the furnace. Most mechanical batch chargers are adaptable, including screw, pushers, and enfolding types. Some designers place the dog house at a small angle towards the backwall with the idea of decreasing the tendency of batch to travel towards the bridgewall. There are several furnaces operating with two dog houses and chargers, one on each side of the furnace. These designs are more costly but may be justified by obtaining more uniform distribution of batch in the furnace.

The fuel requirements, rate of melting, glass quality, and furnace life are factors to be considered in comparing the performance of one furnace with another. Table I shows performance data of a well designed end port furnace producing amber container glass over a four year period.

Table I

Performance Data

	Major Repair Jan. 12, 1952 to Jan. 9, 1954	Minor Repair Jan. 23, 1954 to Dec. 29, 1954	Minor Repair Jan. 10, 1955 to Dec. 24, 1955	Totals
Days Life	729	336	349	1,414
Operating Days	715	334	344	1,393
Tons Drawn/Day	66.4	69.7	72.1	69.4
Sq. Ft/Ton	4.5	4.3	4.1	4.3
Gals. Oil/Ton	46.2	43.3	49.1	46.1
KW/Ton*	0	69	67	34
Homogeneity	B	B	B	B

*Estimate

For the first two years of operation, the load averaged 66.4 tons per operating day, which is equivalent to a melting rate of 4.5 square feet per ton of glass. The fuel consumption averaged 46.2 gallons of Bunker C oil per ton of glass melted.

After running 929 days, the furnace was cooled down for minor repairs to the throat and shadow wall during which time an electric booster system was installed. After another 336 days of operation, the furnace was again cooled for additional repairs to regenerator crowns and to feeders. Following this, an additional run of 349 days was made before the furnace was brought down for a major rebuild.

Over the entire period of 1,393 operating days, an average daily load of 69.4 tons or 4.3 square feet per ton was maintained using an average of 46.1 gallons of oil per ton. During the third and fourth years of operation an average electric input of 68KW per ton was used in addition to the fuel oil. Similar results are being obtained with other end port furnaces of varying sizes using both oil and natural gas fuels.

Melting rates below four square feet per ton are being maintained over the entire life of the furnaces. At these melting rates, the usual experience for furnace life is between three and four years including one or two minor repairs after 24 to 30 months of continuous operation.

Fuel consumption averages between 40 and 48 gallons per ton or 5,700 to 7,000 cubic feet of natural gas. The quality of glass is comparable to that produced by furnaces of other designs.

The Friday morning session was capably guided by Ralph T. Brannan, Owens-Corning Fiberglas Corporation, Newark, Ohio, who introduced the various speakers. The first paper was "Automatic Recording and Controlling of Flue Gases for Glass Furnaces", by Robert K. Gunsaulus, Bailey Meter Company, Detroit, Michigan.

When the constituents of fuel are burned, oxygen is mixed with carbon and hydrogen. Under the correct conditions of time, temperature, and turbulence, a chemical reaction is obtained which produces heat, carbon dioxide, and water. For theoretically perfect combustion, the exact amount of oxygen required would have to be combined with all of the fuel at the proper temperature and with sufficient time allowed for the reaction. In practice this perfect combustion cannot be obtained because of many factors; therefore, excess air is usually supplied to assure complete combustion of the fuel. A measurement of oxygen in the products of combustion would give the excess air while a measurement for unburned combustibles would give the amount of air deficiency.

Excess air should be kept to a minimum because it goes along only for a free ride. It contributes nothing to combustion and represents a heat loss which is carried out the flues to the stack. Air deficiency also represents a loss.

On a regenerative type furnace, motor operated transfer valves select the sample tube as determined by the furnace firing. The transfer valves also contain an auxiliary contact which shuts off the inductor water solenoid valves for the sample tube not in service.

The results from the application of the gas analyzer to the glass furnace process have been very rewarding. In most cases, a very substantial fuel saving has resulted. On one installation, furnace pressure and oxygen control were installed about a year after the furnace was rebuilt. Many times addition of this type of equipment to a furnace is made at the time of rebuilding because that is when management will approve the necessary expenditure. However, in this case, it was the only change made to the furnace at that time. A fuel saving of six per cent to eight per cent resulted, and the entire savings could be attributed directly to the improved operation as a result of stable control of the furnace pressure and oxygen.

Other benefits derived are the uniform temperatures resulting from constant combustion conditions. The glass quality can be expected to improve as the melting temperatures are held more constant, thus eliminating one variable in the overall operation picture so that other variables can be better studied to make further improvements. Furnace life as a result of better combustion control is also extended, resulting in more production time and less repair time.

It is most desirable to include a measurement of combustibles along with oxygen determination to obtain the complete combustion results. Actually each function serves to check the other and provides the maximum useful knowledge about the combustion conditions.

If for no other reason, a continuous gas analyzer can be justified on a glass furnace from the fuel savings to be realized. Actual payout of the equipment and installation costs can be realized in less than one year and often in six months' time, thus effecting a continual sav-

ings equaling the installed equipment cost every six months. Many other benefits, which are more difficult to evaluate, have been demonstrated and can be derived by automatically recording and controlling the flue gases.

The next paper presented was "Practical Application of Flue Gas Analysis to Glass Melting Furnaces", Paul M. Spatz, Diamond Glass Company, Royersford, Pennsylvania.

Flue gas analysis is briefly the science of determining air-fuel ratio and the degree of completeness of combustion from analysis of three major products of combustion: carbon dioxide (CO_2), oxygen (0_2), and combustibles mainly in the form of carbon monoxide (CO).

Many different types of instruments are available for the analysis of flue gases. Most instruments indicate the percentages by volume of the various components in the flue gas. Perhaps the most common of these instruments is the ORSAT, which works on the principal of selective absorption of the gases by chemical solutions.

Gas sampling may be accomplished in different ways. Many means are used to accomplish the desired end: among them are inspirators, aspirators, centrifugal pumps, water washers, cyclones, electrostatic precipitators. It is the duty of the furnace engineer to investigate thoroughly the gas sampling system and choose the one best suited to his needs.

Good combustion conditions consistently maintained in the glass melting furnace should be conducive to: good fuel economy; maximum furnace pull; minimum deterioration of refractories in the superstructure, particularly in the ports and upper regenerators; control of blisters; control of glass color (particularly so in multiburner direct fired furnaces); and proper flame geometry (pattern).

From this list it is seen that one cannot overemphasize the importance of flue gas analysis. Checks should be made with sufficient frequency to insure consistent good combustion operation. The furnace engineer should make a graphical representation of combustion checks of the entire furnace often enough to satisfy himself that no freak cycle is taking place within his furnace, and that good combustion is consistent for his entire schedule of tonnages, fuel and air flow requirements, and furnace pressures throughout the campaign.

To apply practicable flue gas analysis to the glass melting furnace the engineer should be sure he has 1) a good sample system designed for his furnace; 2) a sound analyzing device either intermittent or continuous; 3) selected representative points throughout the furnace for complete combustion analysis; 4) proper visual records to give a picture of the entire furnace, combustion and temperature-wise.

With these conditions established, the engineer can then begin to interpret his combustion results. For good combustion the outgoing ports should show a minimum of excess air and combustibles to reduce to a minimum gas losses. This combustion should be accomplished by adjusting primary air at each port for flame pattern and horizontal temperature gradient. Total combustion air supply should then be set to average the required excess air from each outgoing port. The flues and valves should be kept in good enough repair to limit parasite air to a maximum of two per cent as measured in oxygen (O_2). An aid to reduce the entrance of parasite air in the flue is to coat the entire regenerator outside walls from the port floor to the base with boiler seal compound.

"Cooling Wind Control for Forehearths", Paul M. Spatz, Diamond Glass Company, Royersford, Pennsylvania and Richard Post, Brown Instruments Division, Minneapolis-Honeywell Regulator Company, Philadelphia, Pennsylvania, was the next paper presented. The paper was read by Mr. Spatz.

A pneumatic method for automatically controlling cooling wind on the channel of a glass forehearth was described. "Cooling wind" refers to the air that is blown into the cooling section of the forehearth channel superstructure. This wind is needed to cool the glass if its temperature exceeds that required for the forming machine

The cooling wind control system utilizes the output signal of the existing electronic temperature controller for its control signal. If glass temperature increases or decreases from the set-point temperature, the pneumatic output signal of the existing heating controller goes to the combustion air valve and simultaneously to the cooling wind controller.

The cooling wind controller uses this same signal to provide its own controlled output signal to the air motors, which actuate the dampers and butterfly valves. The function of the controller is to apply properly cooling wind so that the desired minimum amount of heating is obtained from the burners. With this system, the cooling wind is automatically controlled just as it would be manually controlled by an expert operator who could devote full time to making adjustments.

In the event that the glass temperature is too high, the fuel supply is decreased, and the cooling wind controller slowly opens the dampers and butterfly valves just enough to cool the glass to the desired temperature. Overcooling does not occur. When the flowing glass requires continuous but variable cooling, the burners consume a preset minimum amount of fuel, regardless of the amount of cooling wind required. In the event the temperature is too low, the heating control increases the fuel supply in order to raise the glass temperature.

The system permits the temperature controller to "line out" quickly after a job change, or set point change. For a set-point change, the total time for line out is less than five minutes for a ten degree shift, and less than ten minutes for a twenty degree shift. The reduction of time for stabilization of temperature after job change will assist in obtaining a higher gross pack.

Chart records show excellent temperature control lines, continually as good or better than when the dampers were manually set at their best position. Savings in fuel consumption result from the maintenance of minimum fuel level when cooling wind is required.

The set point for fuel is easily adjustable to suit operating rates. The range of adjustment on the test installation was varied to provide from $\frac{3}{4}$ inch to one inch fuel header pressure. Both of these settings are below the average for manual damper control.

The cooling wind control is easy to adapt to a standard pneumatic channel temperature controller. Installation can be made at any time without operating delay.

The next paper presented was "Trends in Glass Plant Instrumentation", John R. Green, Industrial Division, Minneapolis-Honeywell Regulator Company, Philadel-

phia, Pennsylvania.

Potentiometric temperature measurements are now accomplished almost exclusively by electronic means, which provide higher precision of measurement and control, as well as longer operating life of equipment and lower maintenance costs.

The measurement of tank temperatures has shown an increase in the number of points being measured throughout the melting and refining sections. Radiation measurement of glass temperatures in the refiner has led to automatic auxiliary firing of these sections, similar in operation to forehearth control systems. The automatic control of regenerative tanks from temperature measurements, which was considered impractical a few years ago, has been successfully accomplished in several plants, both in this country and abroad.

Air preheat temperatures from checker systems can now be accurately measured experimentally with aspirating thermocouple designs which are commercially available. Continuous measurements of glass level in tanks, forehearths or rotary pots, with the associated automatic control of batch chargers or glass flow mechanisms, are being widely used to maintain constant levels within hundredths of an inch, with resultant stability in product weight.

The extended usage of electric melting or supplementary boosting has introduced additional problems in temperature measurements where platinum thermocouples are employed. The use of radiation units for glass temperature measurement obviously eliminates this electrical problem because there is no contact with the glass. Additional experimental work which has been conducted on forehearth temperatures during the past year has indicated the desirability of a better means of measuring glass temperature conditions as actually delivered from the feeder.

Measurement of glass temperature entering a forehearth from the glass tank have been related to gob temperatures, with some surprising conclusions. Any major variation in glass temperature entering the forehearth can cause similar but smaller fluctuations in gob temperatures, even with extremely close temperature regulation at intermediate points of measurement. Glass temperature entering the forehearth increased by approximately 40° over a cycle of several hours' duration with the temperatures held constant at the points of measurement in both cooling and conditioning zones. The record of manifold pressures in the cooling zone shows the control action which has taken place in order to hold the set temperature. The gob temperature, however, did not remain constant, but shows a much smaller cycle of about 10° magnitude, following the tank change by some three hours on a 25-ton pull.

Such variations in gob temperature are occasionally experienced by machine operators who find it necessary to readjust tube height in order to hold close weight tolerances in spite of constant temperatures in each forehearth zone.

In order to secure a continuous record of gob temperatures without interference from periodic sighting upon the shears, the rebalancing circuit of the electronic recorder is automatically de-energized during and immediately following each shear cut by means of a contact made from the forming machine timer.

This practical means of continuously recording gob temperature conditions, which has now been accomplished in routine plant operation for over six months, represents a significant breakthrough toward more efficient operation of forehearths and bottle forming machinery. This measurement logically leads to its employment for the automatic control of forehearth heating and cooling operations. Experimental work in this direction has already been carried on with promising results. The development of a complete control system which is based upon gob temperature measurements now appears to be possible in the near future.

In summary, the trends in glass plant instrumentation continue to provide improvement in measuring means, equipment designs, and control techniques which are applicable to remove more variables from the many operations required to produce highest quality ware at a minimum cost.

The last paper presented at the meeting was "Instrument Application to Glass Container Manufacture," Hayden M. Setchel, Owens-Illinois Glass Company, Streator, Illinois.

The theoretical uses and operation of the various types of instruments now on the market and adaptable for glass-house operation are not as simple and trouble-free as one would like them to be or as the various manufacturers assume.

The human element is the biggest factor to be considered in selecting instruments. Are the men who will be assigned the day to day maintenance of these instruments familiar with radio, television, and electronic circuits? If the answer is yes, then the choice of electronic potentiometric instruments would be the wise choice. Are these men more of the handyman, household electrician type workmen? If so, the shop will undoubtedly be better off with mechanical type instruments. Possibly the best arrangement if at all possible, is a combination of electronic and mechanical equipment with electronic instrumentation on furnaces and forehearth and mechanical equipment on lehrs and metering systems. Another factor influencing type and make of instrument chosen is the ease or complexity of complete overhaul of the instrument during partial or complete furnace rebuild.

Metering of gas and oils, however, presents a different problem. It is desirable on such operations as furnace firing, glaziers and the like, to have a continuous recording so that supervision has a complete picture of the 24-hour operation. A recording type meter is required in this type operation. However, with temperature controllers on lehrs and forehearths, a simple displacement meter which shows only consumption per unit of time is sufficient for the lehrs and forehearths.

For furnace temperature measurement the instrument will be either a radiation type or operate off thermocouples. It is believed by the author that thermocouples are more desirable in that properly annealed wire results in more uniformity from one thermocouple to another than will one radiation head to another.

The problem of forehearth temperature measurement is important. The problem of lens purging and clean, dry air for this purging is even more critical than on the furnace in that the gob shape, gob weight, and actual job efficiency are, of course, under the influence of the

(*Continued on page 62*)

Inventions and Inventors

Annealing and Tempering

Sealing Means For Glazing Unit. Patent No. 2,784,462. Filed January 22, 1954. Issued March 12, 1957. One sheet of drawings; none reproduced. Assigned to Pittsburgh Plate Glass Company by Earl L. Fix.

This invention relates to an improvement in multiple glazed units that comprise at least two spaced panes of glass that are united about their peripheries by a strip.

The most difficult problem to overcome in the development of all glass units has been the provision of a suitable seal to close the pore hole required during fabrication of the assembly.

Within the tapered aperture is inserted a plug of a mastic material that is impervious to water and air. Such a material is a polyisobutylene composition having a molecular weight in the range of 10,000. In order to provide suitable flow characteristics to this plug, the polyisobutylene is modified by the uniform dispersal therein of from 30 to 50 per cent by weight of carbon black having an average particle size of from 45 to 55 millimicrons and a surface area of from 5.5 to 7 acres per pound of the dispersed mixture.

On the outer side of the mastic plug is inserted a metal disc. This metal disc is preferably of lead.

A covering of a synthetic resin material having a high adhesion to glass and the metal disc is placed atop the metal.

The resinous cap is preferably a resinous product sold commercially as Pittsburgh Waterspar Varnish No. 83-210, Hysol 101 or Hysol 2040. Other suitable sealing caps include Waterplug cement mixed with Spar varnish, X-Pandotite cement, or a product sold as EC 801 by the Minnesota Mining and Manufacturing Company.

There were 7 claims and the following references cited in this patent: 2,621,397, Black, Dec. 16, 1952; 2,683,906, Nevins, July 20, 1954; and 2,686,342, D'Eustachio, Aug. 17, 1954.

Feeding and Forming

Method and Apparatus for Making Foliated Glass. Patent No. 2,780,889. Filed August 29, 1955. Issued Feb. 12, 1957. Three sheets of drawings; none reproduced. Assigned to Owens-Corning Fiberglas Corporation, by Walter Frank Fulk.

This invention relates to glass film or foliated glass in the form of flakes and to improved methods and apparatus for producing these materials.

It has been found desirable to have single thickness film and flake for producing reinforcing materials for resin, rubber, asphalt, Portland cement, and the like.

The process comprises forming a cylinder of molten glass, maintaining a slight positive pressure within the cylinder as it is being formed, attenuating the cylinder of molten glass into a thin walled structure, substantially collapsing the cylinder of glass, allowing the cylinder of glass to expand a second time, and then separating the cylinder into two distinct single thickness films of glass. These single thickness films of glass are then either rolled up as film or broken into flakes as may be desired.

There were 10 claims and the following references cited in this patent: 2,251,727, Wellech et al., Aug. 5, 1941; and 2,457,785, Slayter et al., Dec. 28, 1948.

Furnaces

Blower Nozzle. Patent No. 2,774,630. Filed July 17, 1952. Issued Dec. 18, 1956. One sheet of drawings; none reproduced. Assigned to Owens-Corning Fiberglas Corporation by Thomas W. Henry.

The present invention embraces a method and apparatus for producing attenuated fiber by the gaseous blast method wherein the attenuating efficiency of the blasts of superheated steam is improved over prior methods of attenuation.

The secret of the invention resides in configurating blower surfaces adjacent to the path of travel of the gases, whereby the gases engaging the material at a converging angle are influenced to move in directions more nearly in parallel with the locus of movement of the streams of material; in this way more efficient attenuation of the material is obtained with a consequent increase in production of fibers.

The amount of pellets or unfiberized material is substantially reduced by this method and a higher percentage of usable fibers obtained in the end product.

There were 4 claims and 10 references cited in this patent.

Glass Compositions

Glass Composition and Batch Therefor. Patent No. 2,773,775. Filed December 21, 1953. Issued December 11, 1956. No drawings reproduced. Assigned to Libbey-Owens-Ford Glass Company by William C. Levengood.

The fining time of soda-lime-silica glass has been appreciably reduced by the use of sodium chloride. The raw batch consists essentially of the standard batch ingredients wherein sodium chloride is crystallized with the soda ash content of the batch. The sodium chloride amounts to substantially 0.6 per cent to 4.0 per cent of the weight of the crystallized composition.

There were 10 claims cited in this patent.

Glass Wool and Fiber

Making a Glass Fiber Article. Patent No. 2,763,573. Filed June 24, 1952. Issued Sept. 18, 1956. No sheets of drawings. Assigned to Owens-Corning Fiberglas Corporation, by Lawrence P. Biefeld.

This invention relates to the treatment of mineral fibers, such as glass fibers and it relates more particularly to the coating of glass fibers with a composition which is capable of functioning in itself as a size or binder and which renders the glass fibers more receptive to various materials, such as resinous substances.

An example of the treating solution is as follows: A polyester resin may be formed by reaction of 310 parts diethylene glycol and 540 parts maleic anhydride with 0.4 part hydroquinone in 2 per cent solution. Reaction

may be carried out for 4 hours at 146° C. and 1 hour at 200° C. until a resinous product is produced having an acid number of about 30 to 100. Four parts by weight vinyl triethoxy silane is incorporated per 100 parts of the polyester resin in solvent solution and the composition is heated at a temperature of about 300° F. until the diluent is driven off and a reaction product formed. The product may be dispersed in an aqueous medium to produce a treating composition having a solids content of about 20 per cent for sizing glass fibers in forming or for providing glass fibers in forming or subsequent thereto with a base for use in subsequent treatment with resinous materials in the manufacture of composite structures.

There were 15 claims and the following references cited in this patent: 2,491,409, Kropa, Dec. 13, 1949; 2,544,668, Groebel et al., Mar. 13, 1951; 2,552,910, Steinman, May 15, 1951; 2,563,288, Steinman, Aug. 7, 1951; 2,605,243, Sowa, July 29, 1952; 2,607,755, Bunnell, Aug. 19, 1952; and 2,624,720, Hatcher et al, Jan. 6, 1953.

Treating Glass Fibers. Patent No. 2,763,629. Filed March 25, 1952. Issued Sept. 18, 1956. No sheets of drawings. Assigned to L-O-F Glass Fibers Company, by Adolph Gottfurcht.

This invention relates to the treatment of glass fibers and glass fiber products to improve the adhesion thereto of polyester resins.

It has been discovered that stable aqueous solutions of alkenyl silicone esters may be prepared, and also that glass fibers and glass fiber products, when treated with suitable water dilutions of said solutions and dried, have a film or surface treatment which results in greatly improved adhesion of unsaturated addition type polymerizable resinous materials in which the fibrous glass products are incorporated as reinforcing agents. There is also greatly improved resistance of such products to lowering of strength under high humidity conditions or immersion in water.

The solution can best be prepared as follows: A mixture of 2 parts by volume of vinyl triethoxy silane and 18 parts by volume of water is adjusted to a pH of about 4 by the addition of a 5 per cent aqueous solution of formic acid. This mixture is vigorously stirred until a clear solution is obtained. The solution is then diluted with water to 40 volumes and while it is being vigorously stirred, 4.8 volumes of five per cent aqueous caustic soda solution is quickly added. The final solution has a pH of 11.4 and is stable for periods of several weeks or more.

There were 11 claims and the following references cited in this patent: 2,441,422, Krieble et al., May 11, 1948; 2,486,162, Hyde, Oct. 25, 1949; 2,502,286, Sowa, Mar. 28, 1950; 2,574,265, Hyde, Nov. 6, 1951; 2,649,396, Witt et al., Aug. 18, 1953; and 2,688,006, Steinman, Aug. 31, 1954.

Sheet and Plate Glass

Automatic Glass Cutting Machine. Patent No. 2,756,545. Filed November 15, 1952. Issued July 31, 1956. One page drawings; none reproduced. Assigned to Pittsburgh Plate Glass Company by Florian V. Atkeson.

This invention relates to a glass cutting machine and particularly to one embodying an entirely new principle of glass cutting.

A novel concept in the art of cutting glass has been demonstrated. This concept involves applying a compressive bending force to a sheet of glass during the cutting operation and then rapidly but gradually reversing the nature of the force to a tension or opening force thereby running the cut. The running of the cut is not allowed to overrun the cutter wheel, because it has been demonstrated that the cut does not run beyond the point of zero stress. In other words, the cut begins to be run at the point where the compressive force applied in the vicinity of the cutter is changed into a tension force on the glass tending to separate the plurality of sections that are to be cut.

Also another embodiment of the principle has been made to combine cross cutting means to complete the mechanical process of cutting a plurality of block sizes from a larger sheet. As an example, a sheet of window glass which has had edges stripped to finish 84 inches wide and capped (cross cut) to 80 inches long will give 24 factory lights 14 x 20 inches.

Machines have been designed using the described double flexure method to provide the following actions: edge stripping-plate glass rough rolled, window glass, polished plate glass; block or "cord wood" size cutting plate and window glass; circle cutting; pattern cutting (for example windshields and back lights for automobiles).

There were 11 claims and the following references cited in this patent: 2,078,386, Kendis, Apr. 27, 1937; and 2,504,655, Dallas, Apr. 18, 1950.

Grinding and Polishing The Two Faces of Glass Simultaneously. Patent No. 2,757,489. Filed October 16, 1951. Issued August 7, 1956. Five sheets of drawings; none reproduced. Assigned to Pilkington Brothers Limited, by Robert Touvay and Pierre Pillu.

This invention relates to grinding, lapping or polishing the two faces of a moving horizontal ribbon of glass simultaneously by means of pairs of rotating upper and lower surfacing tools.

In the polishing process, when the working surface of a polishing pad operating on the undersurface of the ribbon of glass is below the correct level of the working plane defined by the lower rollers for supporting and moving the ribbon between tools, (for example, owing to its felt wearing more rapidly than that of the other pads mounted on the same polishing tool) the ribbon is deflected when passing over this polishing pad under the pressure of the upper polishing pad and may break if the deflection exceeds a few tenths of a millimeter.

A main object of this invention is to reduce the risk of such breakage of the ribbon by preventing local sagging in a moving ribbon of glass being surfaced simultaneously on both faces, due to wear in the tools.

Accordingly the invention is characterized by utilizing the deviation of the ribbon to initiate resetting of the respective tool in order to return the ribbon in the locality to the intended path of movement.

The invention also comprises the combination, in a glass surfacing apparatus, including pairs of upper and lower surfacing tools arranged to operate on the two faces of a moving horizontal ribbon of glass simultane-

ously and means to rotate the tools in horizontal planes, of sensing means to determine the deviation of the ribbon from its intended path of movement in the locality of a pair of tools, resetting means to adjust the vertical level of the lower tool of a pair and control means to initiate operation of said resetting means to correct for any deviation thus determined.

There were 5 claims and the following references cited in this patent: 1,729,498, Waldron, Sept. 24, 1929; 2,007,507, Steiner, July 9, 1935; 2,003,922, Cole, Mar. 17, 1936; 2,148,744, Hall, Feb. 28, 1939; 2,590,717, Lowe, Mar. 25, 1952; and 2,647,347, Blachette, Aug. 4, 1953.

Tube and Cane Machines

High Frequency Apparatus For Sealing Glass To Metal. Patent No. 2,775,676. Filed October 24, 1952. Issued December 25, 1956. Two sheets of drawings; none reproduced. Assigned to Western Electric Company, Inc., by Doyle S. Granberry and Samuel Kubs.

In the manufacture of electronic apparatus, it is frequently necessary to form a complete seal between glass and metal with the parts in accurate alignment. To effect a proper seal the operation must be performed with the parts at a definite temperature and hence some means must be provided for indicating the temperature while the parts are being heated. This is usually accomplished by means of a thermocouple in contact with the metal part and connected to a temperature indicator. To obtain efficient transfer of heat between the metal part and the thermocouple, they must engage each other with a pressure which can be quickly and accurately duplicated without disturbing the alignment of the parts.

The invention comprises supports for the metal and glass parts including in the support for the metal part a thermocouple controlling a temperature registering unit. The supports are movable relative to each other to compensate for parts of various thickness; a thermocouple, constituting one of three equally spaced elements upon which the metal part rests automatically, assures good thermal contact between the thermocouple and the metal part. With the assurance of correct positioning of the parts and good thermal contact, the circuit to a high frequency coil, which supplies the heat to the metal part and through the metal part to the glass part to cause sealing of the parts, may be opened when the temperature registering unit indicates the maximum temperature desired.

There were four claims and the following references cited in this patent: 1,990,862, Forde, Feb. 12, 1935; 2,480,364, Hansen, Aug. 30, 1949; 2,572,646, Menzel et al., Oct. 23, 1951; 2,639,555, Buttino et al., May 26, 1953: and 2,656,650, Ano, Oct. 27, 1953.

Miscellaneous Processes

Linearly Feeding an Untwisted, Multifilament Strand. Fig. 1. Patent No. 2,729,030. Filed July 2, 1954. Issued Jan. 3, 1956. Four pages of drawings. Assigned to Owens-Corning Fiberglas Corp. by Games Slayter.

The principal object of this invention is to provide a method and apparatus for the feeding of an untwisted multifilament strand at a high lineal speed with sufficient tractive force so that the strand can be attenuated simultaneously and without requiring that the end of the strand be fastened to a tension applying means.

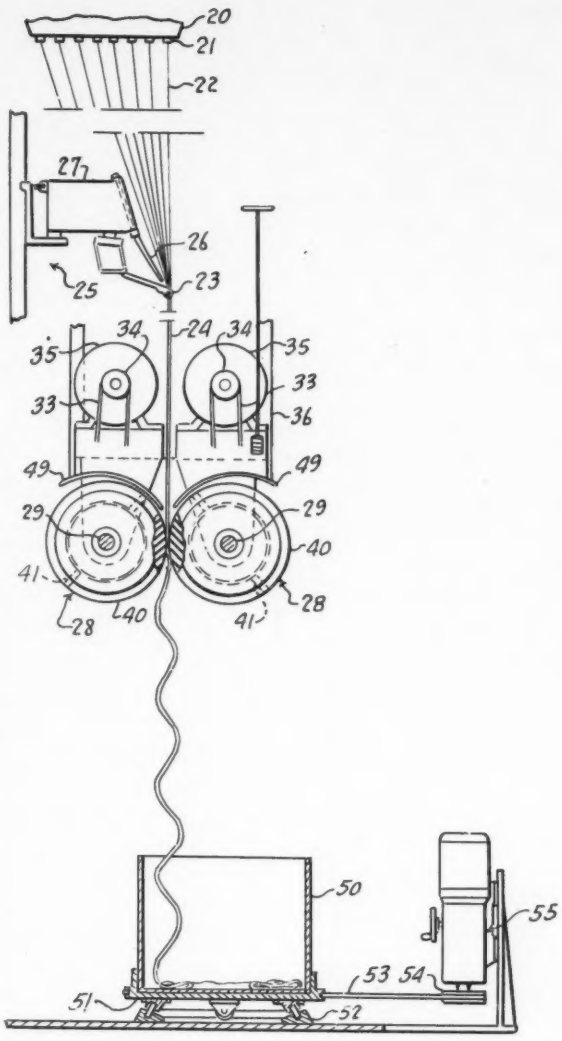


Fig. 1

In Fig. 1 a glass melting tank or bushing 20 is illustrated as having a plurality of stream forming orifices 21 through each of which a fine stream of molten glass flows. The individual streams of glass are pulled downward and, as they cool, attenuated into fine continuous filaments 22 which are grouped together over a guide 23 into an untwisted, multifilament strand 24. The guide 23 is mounted by a bracket generally indicated at 25 and a suitable lubricant or other coating material, for example, simply water, may be dripped onto the guide 23 by a nozzle 26 from a supply tank 27.

The untwisted strand 24 is led downward and between the co-acting peripheries of a pair of high speed rotary pulling wheels 28. Each of the pulling wheels 28 is driven through the medium of a pulley (not shown) in which a belt 33 is engaged, each of the belts 33 being engaged in a motor pulley 34 on one of a pair of driving motors 35 that are mounted upon a framework 36.

Each of the pulling wheels 28 consists of a pair of radially extending wheel disks (not shown), on opposite sides of a spacing ring and held together by axially extending, peripherally spaced bolts. A rim 40 is an annular shaped piece of resilient material clamped between the edges of disks and has a generally circular periphery.

Because the filaments are not twisted or otherwise cohered, the pressure between the peripheries of the rims 40 must be sufficient to squeeze the filaments tightly together to obviate slippage between the filaments and, consequently, damage to the strand 24.

There were 15 claims and the following references were cited in this patent: 2,161,502, Brown, June 6, 1939; 2,323,918, Kierman, July 13, 1943; and 2,447,-131, McDermott, Aug. 17, 1948.

Glass Bending Apparatus. Fig. 2. Patent No. 2,729,032. Filed Dec. 9, 1952. Issued Jan. 3, 1956. One sheet drawings. Assigned Libbey-Owens-Ford Glass Co. by Gerald White.

This invention relates to improved means for locating the end edges of flat glass sheets, either singly or in matched pairs, above a mold shaping surface of desired curvature and for guiding said edges during the bending of said sheets into conformity with said shaping surface.

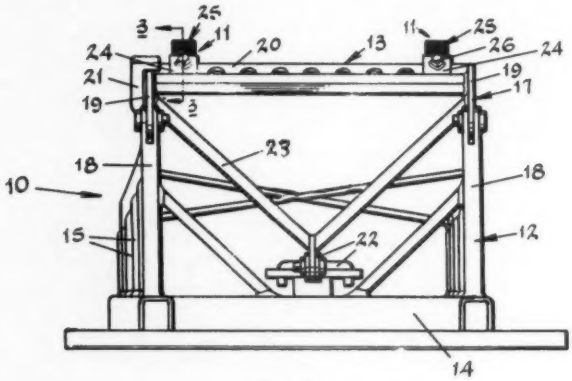


Fig. 2

Dealing specifically with the preferred construction of the novel locating and guiding means 11 of the invention, (see Fig. 2), a pair of substantially U shaped brackets 24 are secured to the outer side of each of the bars 20 slightly below the upper edge thereof to receive a pair of locator blocks 25 which rest upon the lower walls of the brackets and are retained therein by a screw 26 threaded through the back wall thereof.

The locator block 25 includes a vertically disposed core of any suitable hard material which will withstand the bending temperatures of glass such as, for example, "Transite." Disposed around the core and forming a resilient layer of insulating material are one or more wrappings or laminations of glass cloth. One or more wrappings of stainless steel mesh, such as 200-mesh, may be and preferably are disposed around the resilient layer to form a heat-conducting layer for contact with the edge of the glass sheet. An outer layer of sheet metal is then wrapped around the layer and the end thereof suitably secured to provide the block 25 with the necessary compactness as well as a smooth surface over which the glass sheet edges may slide without breakage or chipping.

There were 7 claims and the following reference cited in this patent: 2,608,030, Jendrisak, Aug. 26, 1952.

Decorating Machine. Patent No. 2,739,531. Filed August 29, 1951. Issued March 27, 1956. 6 pages drawings; none reproduced. Lawrence Hagerman.

This invention relates to machines for stenciling decorative markings, lettering and like insignia upon the surfaces of cylindrical articles such as bottles and jars.

The bottles are chucked in the turret assembly so that they may be rotated about their own axes, to receive correct registration and to receive the decoration. Intermittent rotation of the turrent moves the bottles successively to a registration station where they are clutched to a printing spindle for rotation for printing. The register unit comprises a friction drive which rotates the bottle until a small nub or other indexing point on the bottle encounters a mechanical stop. In addition to rotating, the turret is also mounted for movement longitudinally of its axis, the actual movement being only a small fraction of an inch and being cam-actuated. A retractive movement, away from the printing apparatus occurs just as the turret concludes each intermittent movement. This endwise movement of the turret serves to accomplish among other things, the following: it clutches the chuck at the registering station to the friction drive of the register unit; it clutches the chuck at the printing station to the printing spindle; and it releases brake assembly mounted on each individual station of the turret, to permit the respective chucks to rotate. An instant later, when registering of one bottle and printing of another have been accomplished, the turret is allowed to return forward, re-applying the brakes and thereby preventing accidental rotation of the newly registered bottle, and releasing the friction drive and the printing spindle just before the turret resumes rotary movement.

There were 15 claims and the following references were cited in this patent: 2,085,126, Shurley et al., June 29, 1937; 2,183,223, Mankin et al., Dec. 12, 1939; 2,231,535, Jackson et al., Feb. 11, 1941; 2,237,058, Nutt, Apr. 1, 1941; 2,278,570, Shurley, Apr. 7, 1942; 2,307,-404, Heyne, Jan. 5, 1943; and 2,593,627, Stover, Apr. 22, 1952.

Sealing Vacuum-Tight Envelopes. Patent No. 2,749,-668. Filed August 31, 1953. Issued June 12, 1956. Two pages of drawings; none reproduced. Assigned to Compagnie Generale de Telegraphie Sans Fil by Raymond Chaffotte and Pierre Nanchino.

The present invention relates to the manufacture of vacuum-type envelopes, more particularly for use in electron-discharge tubes.

The process according to the invention allows the vacuum tight sealing of at least two parts of an evacuated envelope, at least one of said two parts having an edge made of a vitreous material, said material having a softening temperature at most equal to 600°C. and a melting point substantially higher.

The soldering process comprises the steps of assembling the parts constituting the envelope; applying to

(*Continued on page* 60)

WESTINGHOUSE TO BEGIN PRODUCTION OF QUARTZ TUBING

Westinghouse Electric Corporation has announced that complete facilities for the production of quartz tubing have been installed at its Fairmont, W. Va., plant. Marking the entry of the firm into this field, the facilities will be adequate to all the company's needs for quartz tubing and it is planned to offer supplies of quartz to other users.

One of the chief reasons Westinghouse decided to manufacture its own quartz, according to Mr. Sloan, was to obtain complete control over the quality of lamp products in which quartz is used. Quartz is used in various lamps because of its transparency, high melting point, ability to withstand thermal shock, and ability to transmit short ultraviolet radiation. In some lamps, quartz components must operate at temperatures of 1450 degrees F.

F. C. FLINT, HAZEL-ATLAS, RETIRES

Francis C. Flint, formerly general manager of research and development for the Hazel-Atlas Glass Division of Continental Can Company, has retired effective January 1, 1958, after thirty-eight years of service in various technical capacities with the Hazel-Atlas Glass Company and, later, with the Continental Can Company.

William R. Prindle has been appointed acting general manager of the Hazel-Atlas Glass Division's Research and Development Department. Dr. Prindle, who had previously been the assistant general manager of that department, is a graduate of the University of California with a Master's Degree in Science and of the Massachusetts Institute of Technology with a Doctor's Degree in Science.

The headquarters of the Division's Research and Development Department are located in Wheeling, West Virginia.

LITHIUM PRICES REDUCED

American Potash & Chemical Corporation has announced substantial reductions in the prices of lithium chemicals for the 1958 contract year.

The price of lithium hydroxide is reduced from 75 cents to 55 cents per pound, effective immediately on contract tonnages for carload lots. The less-than-carload lot price has been set at 56 cents. Both prices are delivered.

The sharp reduction in the lithium hydroxide price is due to large quantities available for industrial use as a result of AP&CC's arrangements with the Atomic Energy Commission. Under these arrangements, the AEC buys lithium hydroxide produced at the plant of American Potash's subsidiary, American Lithium Chemicals, Inc., at San Antonio, Texas, and returns lithium hydroxide tails depleted in isotope-6 for sale in commercial markets.

It is expected that the new low price of 55 cents for lithium hydroxide will result in increased usage and expansion of the market, which currently is substantially below the quantity of tails being made available from the AEC's program.

American Potash has also reduced the price of its lithium carbonate from 73 cents to 67 cents for carload lots, effective January 1, 1958, and less-than-carload prices have been reduced by a corresponding amount.

FIRST BOAT SHIPMENT OF FELDSPAR CONCENTRATE ARRIVES

The first boat shipment to this country of feldspar concentrate, produced by a new electrostatic process, arrived at Camden Marine Terminal, Camden, N. J., in November on the cargo vessel, Sunwalt. This is believed the highest quality feldspar ever shipped out of Canada for glass-making use.

Some 4,000 tons of the concentrate, suitable for use in the glass industry without further processing, will be distributed by Golding-Keene Co. of Trenton, N. J., and Keene, N. H., U.S. marketing organization for Spar Mica Corp. Ltd. of Montreal, which mines and processes the raw material.

An air view of the mine, mill and dock area of the Spar-Mica Corporation Ltd., Cape Feldspar, Baie Johan Beetz, P. Q.

Electrostatic separation of feldspar, mica and quartz was perfected by Grant S. Diamond, president of Electro Refractories & Abrasives Corp. of Buffalo and of Spar Mica, of which Electro is part owner and manager. It makes possible a glass spar concentrate with only .05 per cent iron oxide content.

Spar Mica's plant is located on Cape Feldspar on the north shore of the Gulf of St. Lawrence opposite Anticosti Island, only known source of feldspar at tidewater. Newly completed dock facilities 120 feet long can berth 10,000-ton vessels. Loading is automatic by conveyor directly from the plant. The processing plant has an annual capacity of 100,000 tons of the granular concentrate.

Accessibility of the feldspar and mica deposits to bulk shipping is a major advantage. Ships for the first time are now able to carry such cargoes to the eastern United States, Great Lakes ports and Europe.

Spar Mica's holdings on Cape Feldspar are tremendous pegmatite dikes of potash feldspar. The company also owns large mineral deposits in Bergeronnes Township, Quebec, near the confluence of the Saguenay and St. Lawrence Rivers. The latter are rich in muscovite mica suitable for production of ground mica for the roofing, rubber, wall paper and paint industries.

When the Sunwalt was loaded at Cape Feldspar, Rt. Rev. Gerard Couturier, bishop of the Gulf of St. Lawrence, Baie Comeau, Quebec, blessed the workers, the ship and the project before a group of notables, including Dr. B. J. Denis, assistant deputy minister, Department of Mines of Quebec, Quebec City.

GLASS INDUSTRY SEAL FOR USE IN 1958

J. Nelson McNash, board of governors chairman of the American Glassware Association announced that the Association's members and the Glass Container Manufacturers Institute have adopted a seal to be used in 1958 commemorating the 350th anniversary of the glass industry. Establishment of a "glasshouse" in 1608 marked the founding of America's first industry at Jamestown, Virginia, the first English colony on American soil.

Pointing out that the design of the seal provides an equal opportunity for every segment of the industry to enter mutually into an endeavor to make America thoroughly conscious of glass and its myriad products in 1958, Mr. McNash expressed the Association's belief that every division of the industry would want to participate.

Copies of the seal have been sent to all principal glass manufacturers, jobbers' associations and labor organizations suggesting the seal's use in various sizes in advertising, on shipping containers, stationery, company and labor house organs and bulletins, and in postage meters.

The American Glassware Association and the Glass Container Manufacturers Institute have adopted the above seal to be used this year commemorating the 350th anniversary of the industry.

In order to foster immediate recognition of the seal wherever it may appear throughout the country, Mr. McNash expressed the hope that all companies will want to cooperate in maintaining its standard appearance by using it without any change in design. A number of manufacturers are planning to run the seal in two colors; the word "glass" (in a color consistent with colors being currently run) will be used on shipping containers, for example, and the border and other wording will be printed in black.

It is felt that dates limiting the period of the seal's use should not appear on the label (1608-1958), as a number of manufacturers plan to use the seal after 1958. However, a line of type, "350 Years of Progress," will be added by some companies, at their option, under the seal's base line.

• Appointment of H. G. Phillipps, Jr. as manager, Syracuse sales branch, Solvay Process Division, Allied Chemical, was announced by Lester B. Gordon, vice president. Mr. Phillipps succeeds William E. Hess who retired December 31st after 27 years as Syracuse sales branch manager.

W. E. HANFORD AND R. M. FURLAUD PROMOTED AT OLIN

Dr. W. E. Hanford has been appointed vice-president for research and Richard M. Furlaud has been named general counsel, Olin Mathieson Chemical Corporation has announced. Since joining Olin Mathieson last July, Dr. Hanford had been assistant to the president for research. Mr. Furlaud joined Olin Mathieson in 1955 as an attorney in the Legal Department and in May 1957 was named assistant to the president. He remains assistant to the president in his new post.

Robert E. McCormick, formerly general counsel, continues as secretary of the corporation and as a corporate vice president and will assume broadened corporate responsibilities.

Before joining Olin Mathieson, Dr. Hanford was vice president and director of M. W. Kellogg Company. He had been director of research of General Aniline and Film Corporation and before that, spent seven years as research chemist and research group leader with E. I. du Pont de Nemours. Dr. Hanford holds more than 100 patents in the United States and abroad. He has made important contributions to the development of nylon, polyethylene, polyester, elastomers and acetylene chemistry. He also was a leader in the development of the chemistry of fluorocarbons.

L.O.F. BUYS TOLEDO PROPERTY

Purchase of 58 acres of low-lying land on the left bank of the Maumee river in Toledo, Ohio, above Fassett street bridge, has been announced by Libbey-Owens-Ford Glass Company. The property is described as "part of Lower Island" although in recent years it has not appeared as an island. Consideration was $150,000.

It is the site of what was once the Mitchell & Rowland Lumber Co., formerly Toledo's second largest employer. The first lumber mill was built there in 1866 and after several large fires was abandoned in 1904. Old piling is still visible.

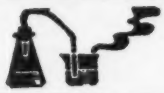
"Libbey-Owens-Ford has acquired this low, swampy land as part of its long-range program for disposal of waste sand from the operations of the Rossford plant on the opposite side of the river," declared Curtis W. Davis, executive vice president, production. "It will be built up approximately 10 feet by pumping the sand waste under the river to the new site by pipeline, when the present disposal areas on Miami street, north of the plant, become filled."

QUALITY CONTROL COURSE OFFERED

The eleventh annual short course in Quality Control by Statistical Methods will be offered by the College of Engineering, University of Illinois, with the cooperation of the Division of Engineering Extenson at Urbana from March 10 through March 20, 1958. Intensive work will be given in the fields of control charts and acceptance sampling with some attention paid to the rational setting of specifications and tolerances. It is designed for those in the areas of design, production, procurement, management, quality control and inspection.

For further information, write to: Professor John A. Henry, Room 205, Mechanical Engineering Laboratory, University of Illinois, Urbana, Ill.

Research Digest



Mixing and Flow in Tank Furnaces

• A VERY LARGE PART of the glass that is manufactured today is melted in continuous tank furnaces. The currents which occur in the molten glass in these furnaces have been the subject of study for at least the last quarter of a century, so that there is now a fair amount of evidence about what happens to the molten glass within the furnace.

How far the quality of the glass depends on the currents within the tank is a question of great practical importance, because if the tank can function as a highly efficient mixer, time and resources spent on improving tank design will yield a high return. On the other hand, if no tank, however well designed, is able to produce a uniform cord-free glass from badly prepared batch, then only the effort concentrated on batch preparation and feeding will yield a worth-while improvement in uniformity of glass.

There are evidently only two ways to get really uniform glass. One is to start with extremely uniform batch and to take great care to avoid its becoming segregated or contaminated during founding into glass. The other is to use ordinarily prepared batch and to stir it during founding with such extreme thoroughness that the inhomogeneities become very finely grained. They will then be smoothed out by diffusion, if given time. P. A. Michaels in the February 1957 issue of the *Journal of the Society of Glass Technology* reviews and discusses the published work on mixing and flow in tank furnaces in order to see whether such very thorough stirring could possibly occur in a tank furnace.

Enough experimental work has been published to give a good idea of what goes on inside a tank furnace and the only conclusion that can be drawn from these reported results is that the best of furnaces is not well enough stirred by convection to produce even mediocre quality glass from badly prepared batch. Very little mixing occurs in the working end, which may contain pockets of stagnant glass persisting for a long time, perhaps during the whole of a campaign. In the melting end, convection currents extend through virtually the whole of the glass, but they are not nearly powerful enough to eliminate cord completely. In fact, they may make matters worse by disseminating cordy material coarsely throughout the whole bulk of the glass.

From what has been said about the adequacy of mixing in the furnace, it is apparent that glass quality depends to a very large extent on the batch. There are three important points to be watched in this connection. They are:

1. The constituents must be accurately weighed out.
2. They must be thoroughly mixed together.
3. The batch must be guarded as far as possible from loss, contamination, or segregation, right up to the time when melting is complete.

These points may be dealt with in turn.

1. When repeated accurate weighing is required, a fully automatic machine is less likely to make mistakes than a human operator, provided that the machine is properly maintained and checked at regular intervals.

2. The difficulty of ensuring thorough mixing depends on the quantity to be dealt with in each single operation. As there are the strongest possible reasons for dealing with batch in as small lots as conveniently possible, the problem of mixing should not be a difficult one.

3. Contamination and loss outside the furnace are avoided by sensible planning and clean and careful working. Segregation is a more serious problem, and may arise both during storage and handling and during melting. Segregation during storage and handling is only avoided by arranging for the absolute minimum of storage and handling of loose mixed batch to take place. This can be done by mixing small quantities as required and by briquetting the batch as soon as mixed. Segregation and loss in melting is prevented by avoiding loose powdery materials and large piles of unmelted batch in the furnace. Here again the continuous feeding of small briquettes seems to provide the ideal answer.

If these measures are not adopted, some palliatives are possible. The particle size of the constituents may be chosen to avoid the fine soda ash being able to settle between grains of coarse material, and control of the water content may be of help. Precautions against spilling of material and return of excess to the wrong bin are, of course, important, and it is essential to avoid mixing and storage of large quantities for long periods. The preparation and handling of batch is a problem for further research.

It seems that there are three directions in which lie the best future prospects of improving the glass-melting process. They are in the improvement of batch preparation and feeding, in the re-design of furnaces to eliminate the large hold-up of glass in the working end, and in the application of quality control chart methods to bring to light fluctuations in glass quality and to locate their causes.

A very excellent bibliography is given by the author in one of the appendices and covers: theory of mixing of liquids; flow and temperature distribution in tanks; scale models of tank furnaces; "intertraction"; and miscellaneous.

PEMCO COMPLETES NEW RESEARCH BUILDING

Completion of the new building devoted exclusively to research and development work for Pemco Corporation has been announced by Dr. George Spencer-Strong, vice president and director of research. The attractive U-shaped building, which lies on a hill east of the main Pemco plant on Eastern Avenue in Baltimore, represents an investment of more than $750,000. With 20,000 square feet of floor space, the new building has triple the space of the previous Pemco laboratories, which were located on Greenmount Avenue near the downtown section of the city.

OVERMYER HOLDS ELEVENTH ANNUAL SERVICE AWARD BANQUET

Overmyer Mould Company's long service employees were honored at the company's Eleventh Annual Service Awards Banquet, held November 25 at Beeson Memorial Club House, Winchester, Indiana.

Earl R. Flatter, vice president, was master of ceremonies. After dinner he introduced the guests of honor, representatives and presidents of the unions to which the employees belong: C. R. Braunagel, Robert Miles, Walter Skinner, Charles McNees and Robert Simmons. In view of the large number of awards, there was no formal speaker.

Lapel pin awards were given to the 10 year employees by Charles Manrose, secretary and treasurer. Max Hawkins, sales manager awarded the lapel pins for 20 and 30 years of service.

Three employees have been with the company since its beginning, and have completed 35 years of service. Special recognition was given this group by Mr. Flatter, who had the privilege of awarding his father one of the diamond lapel pins. At this point Mr. Flatter commented on the company's 25 Year Club and the group of retired employees.

Recipients of 35 Year Service Awards are, left to right, Reginald Elliot, George Flanagan and Carl Flatter. Presentation was made by E. R. Flatter, at left, vice president of Overmyer.

The next awards were made to apprentices who had completed their period of training during 1957. Certificate of completion awards were given to all apprentices. Recognition was given by the department foreman of the various crafts. Ray Conyers made the pattern maker award. Kenneth Stewart recognized the company's first apprentice electrician. Paul Smith made awards to three mould engineers. Wilmer Welch made awards to 16 journeymen mould makers who represented the largest training group.

The featured event of the evening was the presentation of engraved Hamilton wrist watches to the three newest members of the OMCO 25 Year Club, whose wives were in attendance. Oyvin Gustin, Luther Haisley and Edwin Hanke each received a watch from Lowell Roesner, president of the company, who remarked on the significance of the occasion. The evening concluded with a moment of silence in memory of the deceased members of the 25 Year Club.

AMERICAN POTASH EXPLORES MANGANESE ORE DEPOSITS

American Potash & Chemical Corporation has completed arrangements to conduct exploratory investigations of manganese ore deposits at Batesville, Arkansas, according to an announcement today by Peter Colefax, president.

The deposits are located in 10,700 acres of land near Batesville, approximately 100 miles northeast of Little Rock. Mineral rights to the deposits are held by four Arkansas companies, U. S. Manganese Corporation, Arkansas Mining and Exploration Company, Miller-Lipp Corporation and Miller-McGee Manganese Corporation.

Under arrangements worked out by Lehman Brothers, New York investment banking firm, American Potash & Chemical Corporation will investigate both the extent of the deposits and processes to recover the manganese.

If results of the studies are favorable, present plans include formation of a new company to undertake commercial production, with American Potash holding 55 per cent of the stock.

The Batesville properties have been operated independently by the four Arkansas companies for some years on a small scale for the production of limited quantities of manganese ore.

Manganese dioxide is one of the diversified chemicals produced by American Potash & Chemical Corporation at its Henderson, Nevada, plant by electrolytic methods.

C. L. RANDOLPH JOINS U. S. BORAX

Dr. Carl L. Randolph has joined the United States Borax & Chemical Corporation as manager of inorganic boron chemical research, it is announced by Dr. Donald S. Taylor, vice president in charge of the Research Division.

"Dr. Randolph's addition to our staff will reinforce our entire boron chemical development program," Dr. Taylor states, "and will allow us to accelerate our work on many of the newer and more unusual boron compounds."

Making his headquarters at the corporation's new $1,000,000 Research Center in Anaheim, Dr. Randolph will work under the direction of Dr. E. W. Fajans, associate director of chemical research, and will be responsible for projects such as boron hydrides, inorganic boron polymers, and related subjects.

NEW APPOINTMENTS AT CORNING

Two appointments in the Engineering and Manufacturing Staff Division of Corning Glass Works were announced recently by the company. Thomas W. Rochester was appointed to the newly created position of manager of the Furnace Construction Department. William C. Lewis was appointed manager of the Furnace Engineering Department, succeeding Mr. Rochester.

In his new position, Mr. Rochester will manage the construction and maintenance of all furnaces, lehrs and kilns. He has been with Corning since 1939.

Mr. Lewis joined Corning in 1943 as a research chemist. He has held several supervisory positions in the former optical plant in Corning and the Harrodsburg, Ky. plant and for two years served as a research associate in the Research and Development Division.

Current Statistical Position of Glass

Employment and payrolls: Employment in the glass industry during October, 1957 was as follows: *Flat Glass:* A preliminary figure of 29,000 for October, 1957 indicates an increase of 3.6 per cent from the adjusted 28,000 reported for September, 1957. *Glass and Glassware, Pressed and Blown:* A decrease of 1.3 per cent is shown by the preliminary figure of 82,900 for October, 1957, when compared with the adjusted figure of 84,000 for September, 1957. *Glass Products Made of Purchased Glass:* The preliminary figure of 14,200 for October, 1957 indicates an increase of 2.9 per cent from the previous month's adjusted figure of 13,800.

Payrolls in the glass industry during October, 1957 were as follows: *Flat Glass:* An increase of 7 per cent is shown in the preliminary $14,743,325.81 when compared with September, 1957's adjusted $13,772,700.48. *Glass and Glassware, Pressed and Blown:* An increase of 2.1 per cent is shown in the preliminary $30,555,439.40 reported for October, 1957 when compared with the previous month's adjusted $29,929,018.92. *Glass Products Made of Purchased Glass:* A preliminary figure of $4,469,113.84 was reported for October, 1957. This is an increase of 2.8 per cent when compared with the adjusted figure of $4,348,321.49 for the previous month.

Glass container production: Production based on figures released by the Bureau of Census was, 11,366,000 gross during November, 1957. This represents a decrease of 13 per cent from the previous month's production of 13,089,000 gross. During November, 1956, glass container production was 11,895,000 gross or 4.5 per cent over the November, 1957 figure. At the end of the first eleven months of 1957 glass container manufacturers have produced a preliminary total of 135,589,000 gross. This is 3.3 per cent over the 131,308,000 gross produced during the corresponding period in 1956.

Shipments of glass containers during November, 1957 were 12,121,000 gross, or a decrease of 5.7 per cent from October, 1957 shipments which were 12,818,000 gross. Shipments during November, 1956 were 10,290,000 gross or 6 per cent under November, 1957. At the end of the first eleven months of 1957 shipments have reached a total of 132,813,000 gross, which is 1.5 per cent over the 130,807,000 gross shipped during the corresponding period last year.

Stocks at hand at the end of November, 1957 were 16,128,000 gross. This is 4.8 per cent lower than the 16,943,000 gross on hand at the end of October, 1957 and 16.6 per cent above the 13,897,000 gross on hand at the end of November, 1956.

THE GLASS INDUSTRY regrets that starting with this issue the figures relating to the production and shipment of automatic tumbler ware and manufacturers sales of table, kitchen and household glassware will no longer be made available through these pages.

GLASS CONTAINER SHIPMENTS

(All Figures in Gross)

	Nov., 1957
Narrow Neck Containers	
Food	1,085,000
Medicinal and Health Supplies	1,822,000
Chemical, Household and Industrial	826,000
Toiletries and Cosmetics	761,000
Beverage, Returnable	522,000
Beverage, Non-Returnable	72,000
Beer, Returnable	90,000
Beer, Non-Returnable	675,000
Liquor	986,000
Wine	455,000
Sub-total (Narrow)	7,294,000
Wide Mouth Containers	
Food	*3,320,000
Medicinal and Health Supplies	452,000
Chemical, Household and Industrial	178,000
Toiletries and Cosmetics	243,000
Packers' Tumblers	66,000
Dairy Products	234,000
Sub-total (Wide)	*4,493,000
Total Domestic	11,787,000
Export Shipments	334,000
TOTAL SHIPMENTS	*12,121,000

*This figure includes Fruit Jars and Jelly Glasses.

GLASS CONTAINER PRODUCTION AND INVENTORY

(All Figures in Gross)

		Production Nov., 1957	Stocks Nov., 1957
Food, Medicinal and Health Supplies; Chemical, Household and Industrial; Toiletries and Cosmetics	Narrow Neck	4,296,000	5,772,000
	Wide Mouth	*3,933,000	*5,076,000
Beverage, Returnable		549,000	1,789,000
Beverage, Non-Returnable		74,000	222,000
Beer, Returnable		103,000	304,000
Beer, Non-Returnable		702,000	697,000
Liquor		950,000	1,328,000
Wine		477,000	560,000
Packers' Tumblers		44,000	276,000
Dairy Products		238,000	104,000
TOTAL		*11,366,000	*16,128,000

*This figure includes Fruit Jars and Jelly Glasses.

BERKSHIRE CHEMICALS TAKES OVER VITRO SALES

Berkshire Chemicals, Inc. of New York has taken over all the sales activities of Vitro Manufacturing Company of Pittsburgh, Pa., leading ceramic color producers, as of November, according to an announcement by Joseph Boyce, Vitro Manufacturing Company general manager.

Berkshire, a wholly-owned subsidiary of Vitro Corporation of America will maintain the same sales staff which has served Vitro Manufacturing, a Vitro division.

PITTSBURGH PLATE TO BUILD FIBER GLASS YARN PLANT

Pittsburgh Plate Glass Company disclosed recently that it will build one of the world's largest continuous fiber glass yarn plants at Shelby, North Carolina. A multi-million dollar plant, the new unit will employ approximately 850 persons at capacity operation.

Daniel Construction Company, of Greenville, South Carolina, has been selected as general contractor, according to Robert A. McLaughlin, general manager of the company's fiber glass division. Construction work will get underway as soon as contracts for utilities have been signed and options have been exercised on the plant site. He said that the company holds options on approximately 135 acres of land in Cleveland County about six miles west of Shelby.

Mr. McLaughlin said that the one-story structure will contain more than 350,000 square feet of floor space and will be completely air conditioned.

The plant structure is scheduled for completion twelve months after construction begins; partial production is expected to start as soon as the building is completed.

Pittsburgh Plate Glass Company entered the fiber glass production field in 1951 with a plant at Shelbyville, Indiana. Because of the similarity of names in the two fiber glass plant towns, the new factory will be called the Carolina fiber glass plant.

All known types of continuous yarns will be produced. The new unit will have 16 glass furnaces capable of producing 25,000,000 pounds of yarn a year. It will employ the direct melt system of making continuous yarn and yarn will be twisted and plied on ring twisters specifically engineered for the plant.

Mr. McLauglin said that two furnaces will be completed and ready for production when the structure is completed. Installation of the additional 14 furnaces will require an additional 18 months. The glassmaking area of the new plant will operate three shifts each day through a seven day week.

CORNING ANNOUNCES NEW SILICA GLASS TUBING

Precision bore 96 per cent silica glass tubing with inside diameter tolerances up to ±.0005 inches has been announced by Corning Glass Works. Vycor brand tubing can be manufactured with precision bores in diameters ranging from ⅛ to 3 inches. Maximum length of the tubing presently is 36 inches.

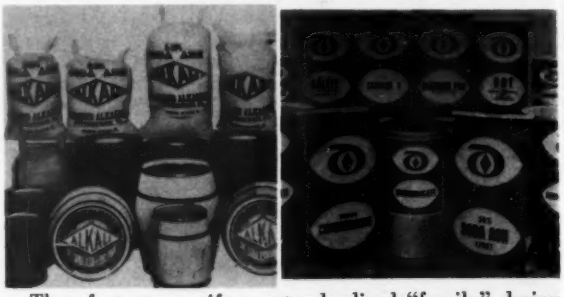
Special slots or indentations on the inside of the tubing can also be made with precision tolerances. Width dimensions can be held to ±.003 inch; depth of indentations can be held to ±.002 inch. Extremely low thermal expansion, excellent dielectric characteristics and chemical stability of Vycor brand glass give the new precision bore tubing excellent properties for high standard electronic equipment.

• American Potash & Chemical Corporation has opened a new district office at Columbus, Ohio, covering outlets in Ohio, eastern Indiana, southern Michigan and Kentucky.

Chester A. Lawton, who has been with AP&CC since 1950 as district representative in the midwestern area, has been appointed manager of the new district office.

PACKAGING PROGRESS AT DIAMOND ALKALI

Results of packaging progress at Diamond Alkali Company, Cleveland, Ohio, are demonstrated by two "before and after" photographs. Taken 45 years apart, they show some of this chemical producer's original product line as packaged in 1912 in then-popular containers, at left, compared with some of the more than 100 Diamond chemicals for industry and agriculture now packed and shipped in new, improved packages, at right.



They feature a uniform, standardized "family" design theme with an inherently high remembrance value to promote brand identification. Basis of the distinctive design, carried out in contrasting black and bright red, is the company's recently introduced trademark, "The Chemical Diamond", which frames a vertically positioned diamond with a new shape inspired by the traditional chemical retort and the calligraphic letter "d" from a fifteenth century French manuscript. The "family resemblance" design treatment was developed by Royal Dadmun & Associates, Inc., industrial design consultants, Baltimore, Maryland, in cooperation with the Company's packaging committee headed by William H. Evans, vice president.

C. F. HEGG DIRECTOR AT L.O.F.

Clinton F. Hegg has been elected to the board of directors of L.O.F. Glass Fibers Company, it is announced by G. P. MacNichol, Jr., board chairman, and R. H. Barnard, president. Mr. Hegg is vice president and general sales manager of the firm.

He has been allied with the glass industry since 1939 when he joined the Libbey-Owens-Ford Glass Company as a sales representative in the Dallas, Texas district. When LOF established its Fiber Glass Division in 1951, Mr. Hegg became general sales manager. In 1955, the Fiber Glass and Corrulux Divisions of LOF merged with Glass Fibers, Inc., to form L.O.F. Glass Fibers, and he joined the new firm as a vice president.

In his new directorship, Mr. Hegg joins these board members: Mr. MacNichol, chairman, Mr. Barnard, John D. Biggers, F. Earle Cazayoux, Thomas A. Collins, Curtis W. Davis, D. Dean McCormick and Gordon W. Reed.

J. R. HENSLER IS APPOINTED

Dr. J. Raymond Hensler has been appointed acting head of the Glass Technology Department in the Chemical Research Laboratories of the Bausch & Lomb Optical Company, according to N. J. Kreidl, chemical research director. Dr. Hensler graduated in 1946 at Penn State where he obtained his PhD. in ceramics in 1951. He has published extensively in the field of glass science.

New Equipment and Supplies

NEW METER MEASURES LOWER FLOWS

C-Mar Corporation, 35 Euclid Avenue, Manasquan, N.J. has developed a new type of flow meter, said to embody a new design principle, for measuring low flow rates and providing new standards of float stability under fluctuating line pressures.

Known as the MB Series Tapor-Flo flow meter, this all-glass, variable area flow indicator is designed primarily for use in research laboratories, pilot plants, and bench-scale operations. An important feature of this meter is its outstanding stability. The float lines out quickly without bobbing, to permit exact reading of flow value without visual averaging. Easy installation, maintenance, and range change are other advantages claimed for the Tapor-Flo design.

Generally pipe-supported or mounted with a clamp on a laboratory ring stand, the MB Series meter is available with either serrated glass connections, standard taper ground glass joints, ball joints, or standard Corning glass flanges (for use in glass pipe lines). Standard flow tube sizes are ¼ or ½ inches I.D. Special sizes or connections are available on order. Maximum operating pressure is 80 psi at 70°F. and maximum operating temperature is 150°F.

Flow range depends on the specific gravity of the fluid, the size of the flow tube and the weight of the float.

A special version of the MB Series flow indicator has a high-low range feature. The flow tube of this instrument has a narrow taper on the lower half of the orifice and a wider taper on the upper half. Consequently, the instrument will measure extremely small flow rates on the lower 50 per cent.

NEW SPEED DRIVES

General Electric, Direct Current Motor and Generator Department, Schenectady 5, N. Y., has available a new line of packaged adjustable speed drives. Designed for minimum maintenance, these speed variators may be obtained in ratings from three through 150 hp and in speed ranges of 8 to 1 and higher. They are designed for use wherever adjustable speed for fine control is needed.

A new regulator with silicon rectifiers is standard on the new line. The regulator, it is claimed, provides smooth, timed acceleration and deceleration to preset speeds in addition to voltage regulation. A new static exitation system with silicon rectifier has no moving parts and requires no warm-up period.

The motor-generator set is of two-unit, four-bearing design. The 55 a-c motor and d-c generator, are connected by flexible coupling for ease of service. Standardized power unit control devices are unit-mounted and front-connected. Recessed wiring troughs eliminate wiring harness and improve accessibility. Incoming power and control connections are simplified by terminal boards.

The units are smaller and lighter, and can be installed end-to-end, end-to-wall or within six inches of back wall.

COLORIMETRIC TITRATION ACCESSORY KIT

Fisher Scientific Company ,498 Fisher Building, Pittsburgh 19, Pa., has produced an accessory for use with the company's electronic colorimeters which is said to multiply their versatility by enabling the chemist to perform titrations using colorimetric endpoints without the uncertainties of the human eye.

The new colorimetric titration kit consists of a magnetic stirrer for sample mixing which is concealed inside the photometer except for the switch, and a hinged lid assembly for introducing a standard or micro buret into the cell compartment. Standard 60-ml and 23-ml cells and even 100-ml beakers can be used for titrations. By the proper choice of filters the operator can measure the absorbance of the sample during titration. A sudden change in absorbance indicates the endpoint; the exact endpoint is obtained graphically from the intersection of two straight lines on a plot of ml absorbance vs. absorbance.

The accessory is claimed to be simple to install and operate, as well as inexpensive.

PYROCERAM CEMENT

Corning Glass Works, Corning, N.Y. has announced the development of a Pyroceram brand of cement. Unlike most cements and solders, its service temperature is as high as its sealing range, 400-450°C. The cement can be used to seal most glasses, including lead, lime and barium-flint types,seramics to glass, ceramics and metal to glass, and metal to metal, such as chrome and nickel stainless steels. It is now being used to seal the face panel to the funnel of all-glass color television tubes.

The softness of the cement in its glassy state allows sealing between 400 and 450°C. A short heat treatment transforms the cement into an extremely strong glass-ceramic. In most glass-to-glass seals, the ceramic bond is stronger and harder than the parts, even at elevated temperatures. Materials to be sealed with the cement must have an expansion between 85 and 110 x 10^{-7} inch per inch per degree C. and be able to withstand the sealing temperature.

CATALOGS RECEIVED

The Beryllium Corporation, Reading, Pa., has issued an 8 page folder describing "Berylco" beryllium oxide, a refractory oxide of the light metallic element. The folder includes discussions on beryllium oxide powder, beryllium oxide crucibles, crucible wash, and shapes. Tables describe the physical and mechanical properties and a typical analysis. A listing of available standard size beryllium oxide crucibles is given. The folder may be obtained by writing to the company's advertising department.

Wall Colmonoy Corporation, 19345 John R. Street, Detroit 3, Mich., has prepared Engineering Data Sheet No. 42A describing the use of cast Colmonoy inserts in glass bottle machines. The data sheet explains the theory of using wear-resistant inserts in thimbles and details the application procedure with a series of photographs. Protection for glass plungers is discussed and a table of standard insert sizes now available from stock is included. The table gives insert number O.D., I.D., thickness and price.

Leed & Northrup Company, 4934 Stenton Avenue, Philadelphia 44, Pa., has published a 4 page Application Data Sheet, 463-60 about their magnetic O_2 system for flue gas analysis. Because excess air O_2 is measured directly and sample averaging is representative of actual combustion, this system is said to provide a reliable index of combustion conditions even with multi-fuel firing. The data sheet includes a display of a recently installed O_2 system showing functional relationships of the different units.

Phillips Electronics, Inc., Instruments Division, 750 South Fulton Avenue, Mount Vernon, N.Y. has available a new 8 page booklet which gives complete information on the improved Norelco Autrometer, automatic indexing X-ray spectrograph. The text explains the operation of the non-destructive analytical tool and describes how it prints out intensity ratios on 1 to 24 elements in a single sample with elapsed time frequently 1/50th that required for chemical analysis. Procedure is described for handling elements from #12 (magnesium) through those having the highest atomic numbers.

Another section deals with performance and gives details on the sequential goniometer, sample-standard holders, radiation detectors, transformer and X-ray tube, console construction, print-out mechanism, Kv and Ma controls. Specifications are given for the main chassis, console, transformer, water and power supplies. The booklet may be obtained gratis from the company.

HOOKER TO BUILD NEW RESEARCH CENTER

Construction of the Hooker Research Center on Grand Island, N. Y. has begun, it has been announced by officers of Hooker Electrochemical Co., Niagara Falls, N. Y. The initial facilities will be completed by late 1958 or early 1959. Costing approximately $3,500,000, the new Research Center will provide space for about 200 personnel. The company, however, envisions and is planning for considerable expansion of the facilities in the years ahead, Mr. Klaussen said.

The 61-acre site is located near the North Grand Island Bridge, and is bounded by the New York State Thruway to the east. The Research Center will face the river and Navy Island in a scenic setting. The spray from Niagara Falls rises in the distance while Hooker's Niagara plant, six minutes drive from the site, is visible across a broad stretch of the river above the Rapids.

The new Research Center is of the latest modular design and will combine the best features of some dozen modern research centers visited by company officials prior to final formulation of plans. All building areas will be connected and will initially utilize about 69,000 feet of floor space.

Planned for the future are an auditorium, a research office wing, an extension to the initial laboratory wing, a duplicate laboratory wing, and expanded storage for solvents.

Architectural design and construction is in the hands of Wigton-Abbott Corp., Plainfield, N. J., leading specialists in the building of research laboratories.

T. E. MOFFITT NAMED PRESIDENT AT HOOKER

The board of directors of Hooker Electrochemical Company, Niagara Falls, N.Y., has recently elected Thomas E. Moffitt company president. He succeeds Bjarne Klaussen who will continue as a director and who had served for nearly a year beyond the company's normal retirement age of 65 by special request of the board. Mr. Moffitt had been a director and executive vice president since January 1956.

During the same board meeting, the directors also voted several other changes. Ansley Wilcox 2d, who has been secretary and general counsel, was in addition elected a vice president. Thomas F. Willers was elected a vice president and treasurer and will also continue as comptroller. Dennis A. Riordan, formerly treasurer, plans to retire. Mr. Willers, who had been assistant treasurer, succeeds him in this position. John F. Snyder retires as vice president but will remain as director and member of the finance committee. J. Clarke Cassidy, a director and former vice president, has been appointed to the finance committee, of which Edwin R. Bartlett is chairman. R. Lindley Murray continues as board chairman and chief executive officer.

BOOK REVIEWS

A modern Russian-English Physics Dictionary in permanent, case-bound, indexed form, has been announced by Consultants Bureau, 227 West 17th Street, New York 11, for publication in 1959, at $50.00. In the interim, word-equivalent glossaries on special fields of physics are in preparation and will be sold upon publication (in limited quantities) at $10.00 each. Pre-publication subscribers to the Russian-English Physics Dictionary will receive, not only the final Dictionary, but also, immediately upon publication, each glossary at no additional charge. The glossaries are as follows: Nuclear Physics and Engineering (published, still available); Electricity and Magnetism; Electronics; Liquids and Hydraulics; Acoustics and Shock Waves; Mechanics and General Physics; Solid State; Atomic Physics, Spectroscopy, Optics.

In addition to their work on Consultants Bureau's own Russian journals-in-translation, the publisher's physicist-translators have for years worked on Consultants Bureau's translations for U. S. Government agencies, American Institute of Physics and private industry. Consultants Bureau has 10 years of specialized experience in scientific translation. The Russian-English Physics Dictionary and each glossary, will as a result contain thousands of terms not otherwise accessible, many of them ordinary Russian expressions and idioms having special meanings in the various fields of physics.

The Physical Chemistry Section of the Proceedings of the Academy of Sciences, USSR (Doklady), covering the most advanced Russian research in physical chemistry, is now available in complete English translation, from Consultants Bureau, 227 West 17th Street, New York 11, at a yearly subscription rate of $160.00.

The papers contained in Doklady: Physical Chemistry Section are concise reports by the leading Soviet physical chemists on their most recent and significant research. The section therefore presents a comprehensive survey of the most advanced Russian research in physical chemistry, including reports on: chemical kinetics; interface phenomena; electrochemistry; absorption spectra; etc. Originally published in 36 issues, it is published by Consultants Bureau in six issues per year. Translation began with the 1957 volume. Single articles are available at $5.00. Tables of Contents will be mailed free on request.

Consultants Bureau's English translations of Doklady: Physical Chemistry are by physical chemists, equally familiar with Russian and the technical terminology. Journals are staple bound, and include all diagrams, photographs, and tabular matter integral with the text.

CHANGES AT CORNING

Four organization changes at Corning Glass Works were recently announced by the company.

Clark A. Crawford has been named to the new position of assistant coordinator for Pyroceram. In his new position, Mr. Crawford will assist in coordinating the research, production and sales activities required in the manufacture of products made of Pyroceram, the new family of glass-ceramic materials.

A. Russell Arnold will succeed Mr. Crawford as manager of the Pressware plant in Corning, N. Y. William E. Stroud will replace Mr. Arnold as manager of the company's plant at Danville, Ky. John W. Spiegler will follow Mr. Stroud as chief engineer of the electronic components department in the Electrical Products Division.

premeditated performance

IN METALS FOR MOULDS

Introducing Overmyer's new electric induction furnaces, inspired and planned by Overmyer's Research Division to provide a wider range of mould irons and steels for the glass industry. Part of a recent and extensive foundry expansion, these furnaces provide higher quality ductile iron of established consistency, free of undesirable elements, and afford absolute chemical compound control, hence absolute quality control. In using these new furnaces to produce the highly alloyed iron necessary for today's glass machines, Overmyer can supply any mould metal for any requirement of the glass industry – and faster delivery to customers. Overmyer Mould Company, Inc., Winchester, Indiana; Greensburg, Pennsylvania; South Gate, California; Fremont, Indiana.

HIDDEN COSTS
in
RAW MATERIALS?

Yes, often there are hidden costs in raw materials and Calumite offers advantages which help to eliminate them.

In addition to greater glass stability, easier melting and increased production, Calumite provides these extras:

- **less superstructure attack and less stone loss.**
- **markedly reduced volatile attack and batch carry-out.**
- **longer checker life and furnace efficiency.**

Calumite, in delivering these "extras", helps to eliminate the hidden costs in raw materials.

The Calumite Co.
HAMILTON, OHIO

The Glass Industry . . .

(*Continued from page* 26)

of both countries to date remains a so-called chemical grade, while the development of a glass grade has advanced to the large pilot plant stage at the present time. There is a real prospect of a glass grade spodumene being available for glass industry in the latter part of 1958. This prospect has considerable significance in view of the large tonnage reserves of spodumene on this continent, providing the glass industry the security of a domestic over an imported foreign supply of lithium mineral as well as the prospect of lower cost lithia values.

It is not expected that spodumene per se will supplant lepidolite in borosilicate glasses. However, it may very well be the preferred mineral for television glass.

It is also believed that lithia may aid the container glass industry by increasing melting rates. There are a number of projects under way to investigate this use.

IX. NEW DEVELOPMENTS

Pyrex Brand Accu-red Pipettes

Serological and measuring (Mohr type) pipettes manufactured with extremely accurate bores are now being produced.

The new Pyrex brand Accu-red pipettes can be calibrated and marked in a single operation, as the result of a new manufacturing method. With lowered production costs, the pipettes are available at saving up to 15 per cent.

The pipettes are made of chemically resistant Pyrex brand glass 7740. They are unaffected by sterilization and are chemically stable.

Both graduations and sight lines of the pipettes are in permanent Lifetime Red markings that are actually part of the glass itself. They stay sharply legible for the life of the pipette.

Food Containers

Metal mess trays, once a perpetual basis for military complaints, are on the way out—at least in the Air Force.

Food Service Officials of Air Force Services Division, Air Materiel Command, have announced that as a result of year-long tests, Corning Double-Tough brand individual table ware will replace tin trays in all Air Force dining halls.

The tempered glassware was chosen because it has proven to be "the most nearly perfect" sanitary surface and because it is less likely to break than ceramic products.

Use of tableware in place of tray serving is also expected to reduce waste food costs considerably, the military group said.

Metallized Glass Printed Circuit Boards

Metallized glass printed circuit boards for high temperature applications under high humidity conditions are now available.

Made of Fotoceram, the strongest of Corning's photosensitive glasses, the new printed circuit boards can withstand a continuous operating temperature of 500°C. Electrical resistivity is excellent. These design advantages make them especially suitable for missile applications.

Because Fotoceram has an etching ratio fifteen times higher than conventional glasses, Corning's printed circuit board is able to feature extremely small, close-tolerance holes with close center-to-center distances.

Corning printed circuit boards are now available in thicknesses (after etching) of 0.050, 0.063, 0.075, 0.115, 0.140, 0.170, and 0.235 inches. Maximum size available is 12 x 18 inches.

Fused Silicon Windows

There have been developed fused silica windows, available up to 17 inches in diameter, which have high transmission in the ultraviolet range and do not darken under gamma radiation and electron bombardment. With high electrical resistivity and low dielectric loss (less than .0008 at 200°C and 1 megacycle), fused silica glass makes an excellent insulator for high voltages.

The extremely low ultrasonic attenuation of this material (less than .03 decibels per foot per megacycle) also makes it an ideal medium for solid ultrasonic delay lines.

Camera Windows

An application of fused silica windows is found in camera windows, maintaining high optical qualities under extreme temperatures experienced in wind tunnel operations and ultrasonic missile work are now available.

Made of fused silica, the windows have a low index of refraction variation (of the order of 2×10^{-6} per inch). They can withstand temperatures up to 990°C.

Fused silica windows can be used to protect cameras and other delicate recording instruments from skin temperatures of high speed aircraft or guided missiles.

The windows are extremely resistant to thermal shock. They have a thermal expansion coefficient of 5.6×10^{-7} per degree C.

All Glass Y-Type Valve

An all glass Y-Type valve which is virtually impervious to corrosion has recently been shown. Made of tempered Pyrex brand borosilicate glass, the new two-inch valve is corrosion resistant, compact, lightweight, tough and versatile.

All working parts of the new valve exposed to fluid are of glass or Teflon. Acidic fluids of all concentrations or compositions at temperatures as high as 250°F, can be handled by the valve. It is recommended for use in processing all acidic metallic salts, various crystalline slurries, and all acids except hydrofluoric and hot concentrated raw phosphoric acids.

Low thermal expansion of the glass allows a sudden temperature differential through the valve of 200°F. Maximum line pressure at the valve is 50 pounds per square inch.

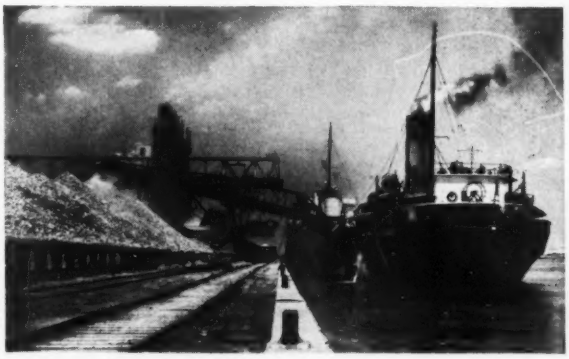
The spring-loaded stem of the valve keeps the plug tight when closed and holds it in any fixed position until the hand wheel is turned. For additional safety, the tempered glass valve body is armored with a fiber glass-polyester resin sleeve. Weighing only nine pounds, including mounting bracket, the glass valve is 1/3 to 1/4 the weight of conventional two-inch valves.

The new Y-type valve can be easily mounted in any position through 360 degrees. Its versatility is demonstrated by flanging procedure—flanges can be rotated

Milestones in Glass Progress

PHOTO COURTESY CORNING GLASS WORKS

1939 Called the most revolutionary glass in 4000 years, Vycor brand glass is extremely tough, made from 96% silica. It withstands violent changes from hot to cold without injury (above: pouring molten metal inside while resting on ice). Developed in 1939, Vycor is used in laboratory equipment, sun and germicidal lamps.



1890 Michigan Alkali Company, now a division of Wyandotte Chemicals Corporation, was founded by Captain J. B. Ford to supply Soda Ash to the glass industry. At Wyandotte, there is no compromise with quality — insured by rigid tests from arrival of limestone at our docks (above), to final delivery of Soda Ash. Another reason why Wyandotte is a dependable source of raw-material chemicals for glassmakers.

Wyandotte CHEMICALS

Michigan Alkali Division, Wyandotte Chemicals Corporation
Wyandotte, Michigan • Offices in principal cities

Founded by a Glassmaker to Serve the Glass Industry

on the valve body for easy alignment with bolt holes of connecting equipment.

Electrolytic Level Switches

A new line of electrolytic level switches, suitable for missile directional systems is available.

Tiny, arc-shaped gravity sensor devices, unlike mercury-filled levelers, are made for both off-on and proportional control in both vertical and lateral directions. When filled with Corning-developed electrolyte, the switches indicate level and deviation from level within tenths of degrees.

The switch is made of glass tubing, ground to an exacting spherical radius of curvature. One hollow and two solid platinum leads are sealed with precise spacing into its surface. Electrolyte is inserted through the hollow lead, which is then arc-welded closed. Calibration is made during the filling operation.

New Lens

A new round lens has been added to the line of concave Pyrex brand Lenslites.

The lens, 11¼ inches in diameter, is specifically designed to provide efficient illumination, with low brightness at high angles in incandescent lighting fixtures. Average brightness of the new Pyrex brand Lenslite is 117 foot-lamberts at 85 degrees using a 200-watt bulb.

A new square concave Lenslite measuring 7⅞ inches has also been added to the larger 11⅞ and 10⅞ inch units.

For the new round lens, Corning engineers specify use of a double conical matte reflector to achieve proper light distribution. With this reflector the optical system has a fixture efficiency of about 55 per cent.

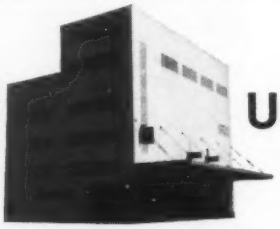
Concavity of the round lens is ⅜ inches at center. The back of each new lens is stippled to provide increased diffusion without loss of light. The front of each lens is a modified Fresnel design, with prisms concentric from the center. Two additional sizes will be announced shortly: 8⅜ inches round, and 8⅜ inches square.

X. FUTURE POSSIBILITIES

The long range future possibilities of the industry are unlimited. The rapid growth of population indicates a continuing need for more homes, more commercial buildings, and more automobiles. All are important users of glass, and in all these industries there is an expanding use of glass per unit.

The present-day glass production is expected to continue unabated, but with current interest in missile propagation assuming profound importance, it is quite logical that the glass industry will concentrate its services to aid studies in this field. Electronic principles are being used increasingly in military equipment, and the growth of national defense emphasizes the importance of the military electronics market. A broader use of glass in this field is anticipated with newer glasses to be developed with unusual and specific properties. Glass-ceramic products will no doubt aid the missile field. Electronic glasses on the other hand will find wider and broader use for the control of such operations.

In view of past and future developments, the glass industry has shown its ability to meet our country's needs.

THIS IS THE  ULTRA-MODERN PLANT

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POTASSIUM CARBONATE

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Snowflake® Crystals • Caustic Potash
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B_2O_3 imparts

improved appearance... thermal stability... strength

Borates OFFERING THE MOST SATISFACTORY SOURCES OF B_2O_3

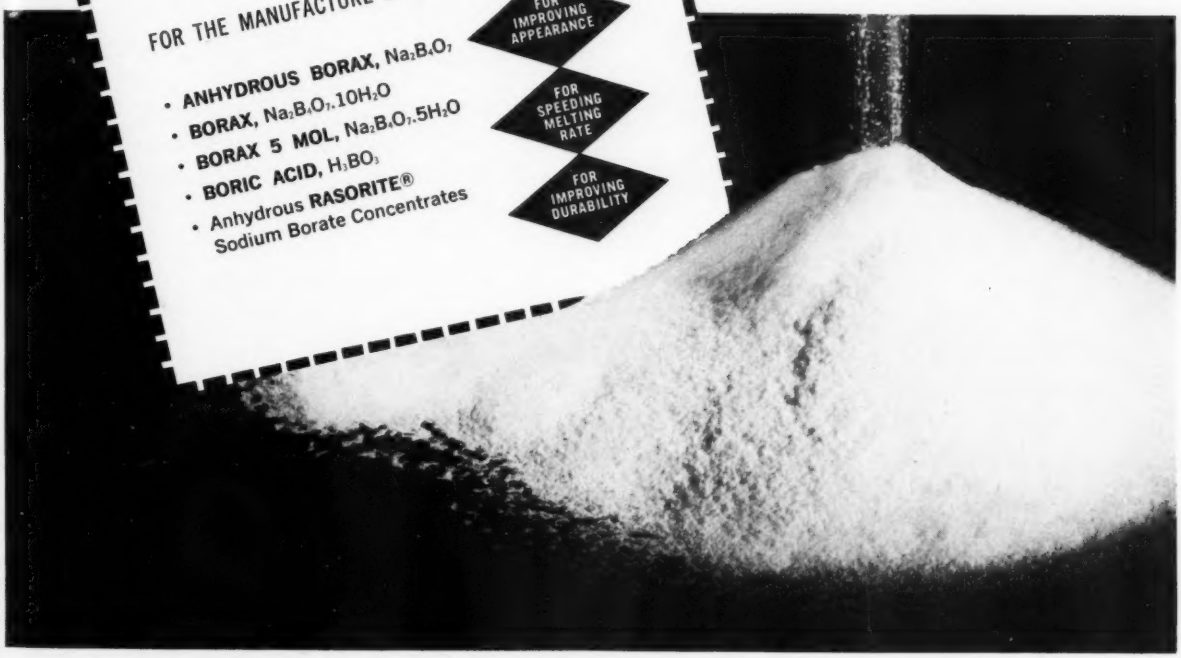
FOR THE MANUFACTURE OF ALL TYPES OF GLASS

- **ANHYDROUS BORAX,** $Na_2B_4O_7$
- **BORAX,** $Na_2B_4O_7.10H_2O$
- **BORAX 5 MOL,** $Na_2B_4O_7.5H_2O$
- **BORIC ACID,** H_3BO_3
- Anhydrous **RASORITE®** Sodium Borate Concentrates

FOR IMPROVING APPEARANCE

FOR SPEEDING MELTING RATE

FOR IMPROVING DURABILITY



Just as boron has long imparted many desirable characteristics to glass, so is it functioning today in a hundred other applications... and new uses are still being discovered. Thus, the demand for boron, now at an all-time high, is getting bigger and bigger daily.

To keep pace with this growth in boron usage, we recently converted our vast orebody to an open-pit operation for faster, more efficient, recovery of ore. Adjacent to the mine, facilities for refining and concentrating the ores have been modernized and greatly expanded. In addition, a new, ultra-modern Research Laboratory has been built.

You can benefit from all of this. For *your* borate requirements, or for technical assistance, look to the leader and specialist in borates!

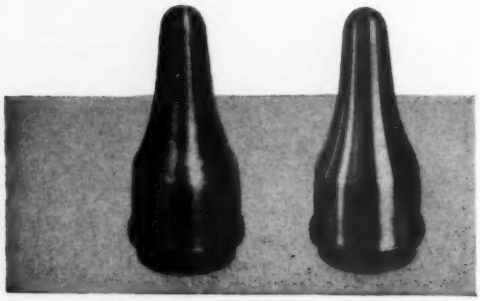
United States Borax & Chemical Corporation

Pacific Coast Borax Company Division

50 ROCKEFELLER PLAZA, NEW YORK 20, N.Y.
630 SHATTO PLACE, LOS ANGELES 5, CALIFORNIA

THERMOSPRAY coated mold plungers give 8 times longer service life

Important savings are being made in production down-time and replacement-part costs on equipment subject to heat and abrasion. Typical of these are mold plungers like those shown here which are being THERMOSPRAY coated by glass manufacturers for protection against heat corrosion. Other advantages include improved product quality, with better finish on glass parts. Longer production runs are feasible without dismantling machines.



Before (left) and after (right) coating with METCO *ThermoSpray* Process. Users report coated plungers last average of 8 times longer than uncoated. Parts finish is improved, production down-time reduced.

The new METCO THERMOSPRAY Process consists of spraying specially developed alloys in powder form with the METCO THERMOSPRAY GUN. These alloys are of the nickel-chrome-boron type and are self-fluxing. No compressed air is required. Coating hardnesses range from Rc 30 (machineable) to Rc 65, depending on the specific THERMOSPRAY alloy used; will even outwear hardened steels from 3 to 10 times. Spraying speeds are higher – 8 to 10 lbs. per hour – and deposit efficiency far greater (up to 97%) – than with any other type of available equipment.

Application of these materials in powder form permits close control of the amount applied and leaves a comparatively smooth surface that requires a minimum of finishing compared to other methods of application.

Free bulletin – write today for Bulletin 126 which illustrates and describes the METCO ThermoSpray Process or ask for a call by a full-time, company-trained Metco Field Engineer in your territory.

The following names are the property of Metallizing Engineering Co., Inc.: METCO, ThermoSpray.*

**Reg. U. S. Pat. Off.*

Metallizing Engineering Co., Inc.
1185 Prospect Ave., Westbury, L. I., New York • cable: METCO
In Great Britain: Telephone: EDGEWOOD 4-1300
METALLIZING EQUIPMENT COMPANY, LTD.– Chobham near Woking, England

A. R. EAKINS AND H. W. GETHIN PROMOTED AT H. K. PORTER

Alan R. Eakins has been appointed general sales manager, and H. W. Gethin named assistant general works manager, Refractories Division, H. K. Porter Company, Inc., according to an announcement by James P. Raugh, vice president and general manager of the division.

Mr. Eakins, promoted from assistant sales manager, was previously with General Refractories Company in various sales positions since 1949. He is experienced in the technical sale and service of basic, silica and clay refractories used in the steel, copper, cement, glass and aluminum industries.

Mr. Gethin is a ceramic engineer and graduated from Penn State University in 1930. He has been with Porter's Laclede-Christy Works since 1944, and previous to that, had 14 years of refractories production experience.

Mr. Gethin will assist E. G. Platt, general works manager, in supervising production of refractory products made at Porter's 14 plants which are located in Missouri, Ohio, Pennsylvania, Illinois, Alabama, Colorado, and Connecticut.

Mr. Gethin is a member of the American Ceramic Society, Association of Iron and Steel Engineers, American Foundrymen's Society, and Pittsburgh Athletic Association.

CONTINENTAL CAN TO HAVE ADVANCED STYLING SECTION

Karl Brocken, American design consultant, has been commissioned by Continental Can Company to create an advanced styling and design section within the company to concentrate upon development of new, unique approaches in the appearance and design of containers and other products. The new styling section will be instituted first in the Hazel-Atlas Glass Division of the company, located in Wheeling, West Virginia. Advance planning will be conducted on glass jar and bottle design as well as the Division's line of consumer products.

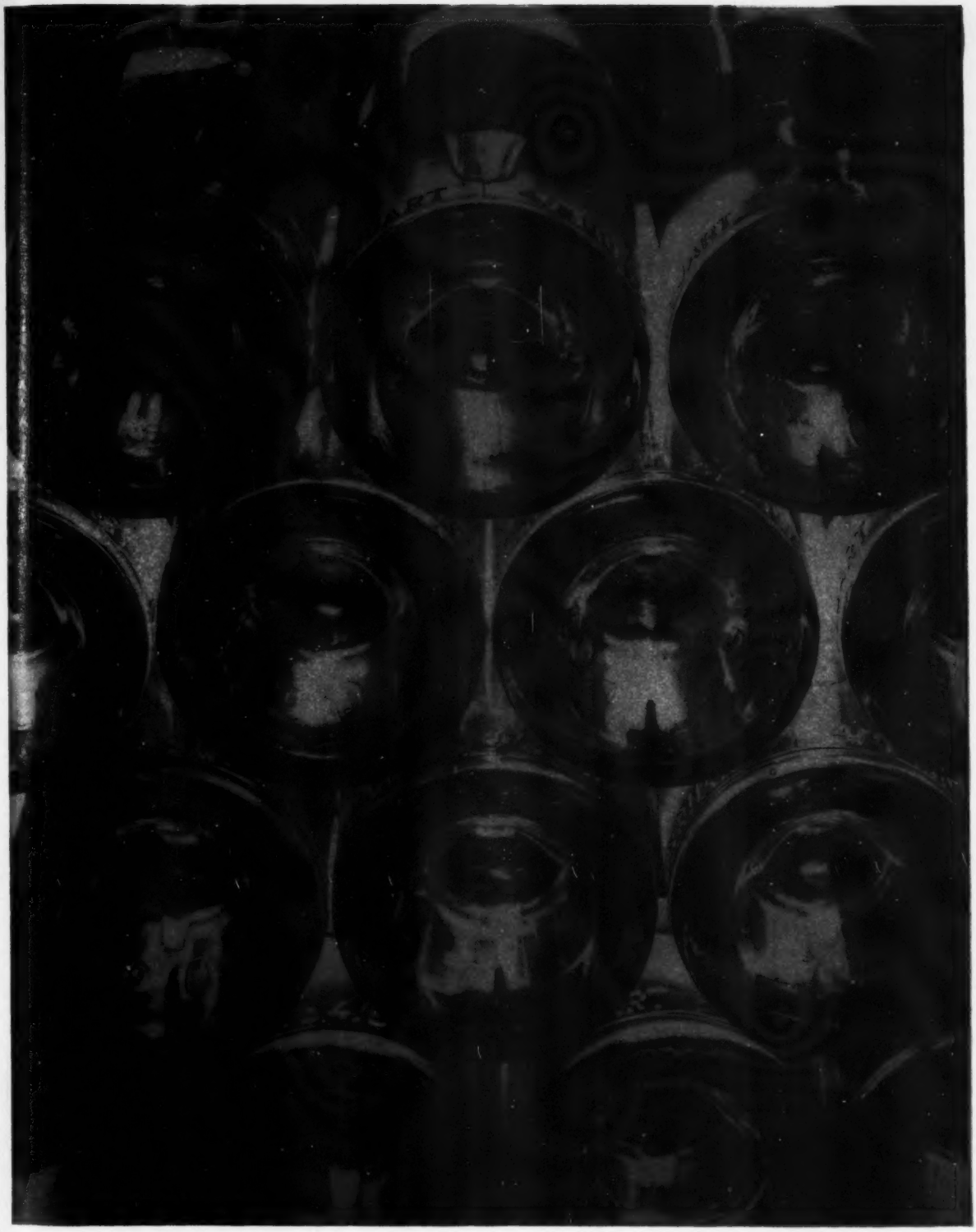
Robert Sanders, former design director of the Sinclair Glass Company, has been appointed director of the new advanced styling and design section.

• Robert P. Stuntz has been appointed assistant sales manager of The Babcock & Wilcox Company's Refractories division, it was reported by James E. Brinckerhoff, vice president. Mr. Stuntz will make his headquarters at the company's executive offices in New York.

THE SHARP-SCHURTZ COMPANY

CHEMISTS AND CONSULTING ENGINEERS
FOR THE GLASS INDUSTRY

LANCASTER, OHIO U. S. A.



Columbia-Southern, a dependable supplier of soda ash to the glass industry since 1899, manufactures its soda ash with extreme care to conform with the characteristics of other raw materials for superior glassmaking

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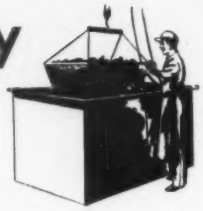
COLUMBIA-SOUTHERN
CHEMICAL CORPORATION
SUBSIDIARY OF PITTSBURGH PLATE GLASS COMPANY
ONE GATEWAY CENTER · PITTSBURGH 22 · PENNSYLVANIA

Soak away



- heat scale
- carbon
- lubricants

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Now all you need is a soak and a rinse to clean your steel molds for bottles, jars, jugs and other items. No more sandblasting, no more scraping. Oakite has developed specialized compounds that do the cleaning chemically — faster, easier, at less cost.

Call your local Oakite Technical Service Representative, or write for details to Oakite Products, Inc., 25C Rector Street, New York 6, N.Y.

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for fast, efficient polishing

CEROX
The original optical grade cerium oxide. Also available in mirror grade.

Prompt deliveries of CEROX in any quantities.

TO COLOR AND DECOLORIZE GLASS

Cerium, Didymium (cerium-free) Salts, Neodymium and other Rare Earths

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HELP WANTED

GLASS ENGINEER

Opportunity for competent graduate engineer with at least five years experience in technical or research work in the glass industry. Immediate function is to provide continuity in several product development projects. Long range potential in top technical management. Write Penberthy Electromelt Company, 4301 Sixth Avenue So., Seattle 8, Washington.

GLASS COLOR TECHNOLOGIST

EXCELLENT OPPORTUNITY FOR CERAMIC ENGINEER OR GLASS COLOR TECHNOLOGIST

Must have experience in development, manufacturing and application of glass colors to glass containers.

Excellent Salary, Fringe Benefit Program, and Future. Must be able to travel.

All replies confidential. Please state qualifications and experience. Box 209, The Glass Industry, 55 West 42nd Street, New York 36, N. Y.

FOR SALE

GLASS-Aluminum Products, est. 10 years, sales-installations, glass blocks, Wisco distributor, Kawneer store fronts, 1956 sales $177,387, N.W. Ohio city, price right. Apple Co., 1836 Euclid, Cleveland, O.

NEW COUNTER-TOTALIZER KEEPS INVENTORY CHECK

A newly developed counter and totalizer enables processors to maintain an accurate inventory check on each ingredient being fed into a proportioning system, it has been announced by Richardson Scale Company.

The new counter records the weight of each ingredient used during any batch or during any required interval of time, and also totalizes the weight of all ingredients used. There are twelve separate counters in the panel, eleven of which are used for eleven separate ingredients; the twelfth counter is used for totalizing. Sizes are available for recording up to a hundred ingredients.

Thus, when any ingredient is used in a batch, the inventory counter for that material will record in pounds the actual weight of material withdrawn from storage and used in the batch; and simultaneously the totalizer counter will also record the actual weight in pounds. When the next ingredient is introduced, the register for that ingredient will record actual weight used and that same amount will be added to the totalizer counter.

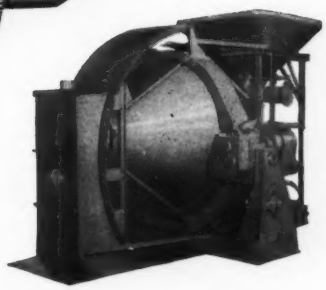
By knowing the amount used, there is always the record immediately available of material left in the storage and the inventory supply may be replenished at the proper time.

Further information may be obtained from Richardson Scale Company, Van Houten Ave., Clifton, N. J.

intimate mix: braiding action

The place to start quality control is in the batch house.

A Smith Tilter actually braids particulate solids into an intimate mix. It is the only mixing drum that directs flow action into cross currents for complete random mix. Then it discharges without the slightest segregation.



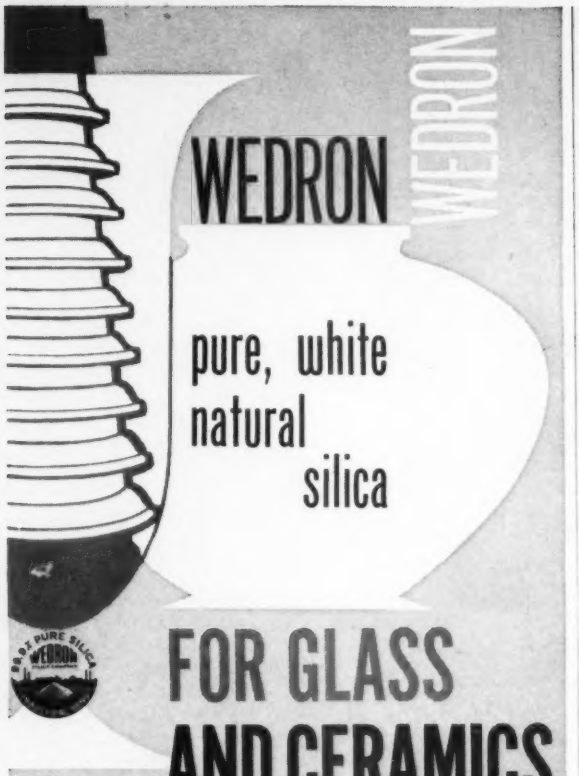
Sizes: 30, 40, 60, 90, and 120 cubic feet, each completely dust-sealed.

THE T. L. SMITH COMPANY
Milwaukee 1, Wisconsin
Lufkin, Texas

Affiliated with Essick Manufacturing Company, Los Angeles, California

SMITH **batch mixer**

A-4020-1P



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WEDRON SILICA COMPANY

135 So. LaSalle Street, Chicago 3, Illinois

Inventions and Inventors . . .

(*Continued from page* 42)

the zone of contact a thermal peak or impulse, the amplitude and duration of which are so determined that the elements of the tube located inside the envelopes are unaffected for the duration of this impulse (or in the case of an electronic tube, the electrodes are protected against contamination) and the vitreous material sufficiently softened; and simultaneously impressing said parts upon each other, thereby constituting a provisional seal having sufficient vacuum tight properties to enable vacuum pumping to a high degree immediately following the thermal peak.

The envelope assembled in the foregoing manner is then subjected to a pumping operation up to a high degree of vacuum and thereafter to the de-gassing thermal treatment, the temperature range of which is lower than the maximum amplitude of the thermal peak, but sufficient for converting the provisional seal by molecular diffusion into a permanent seal.

There were six claims and the following references were cited in this patent: Re. 23,492, Despois, May 20, 1952; 1,206,177, Twyman et al., Nov. 28, 1916; 1,796,401, Sample, Mar. 17, 1931; 2,125,316, Ronci, Aug. 2, 1938; 2,248,644, Reger et al., July 8, 1941; 2,268,670 Ronci, Jan. 6, 1942; 2,464,990, Plagge, Mar. 22, 1949; 2,499,854, Ellefson, Mar. 7, 1950; and 391,245, Germany, March 1, 1924.

E. M. HOMMEL NAMED PRESIDENT OF CERAMICS ASSOCIATION

At a director's meeting of the Pennsylvania Ceramics Association recently held at Mellon Institute, Pittsburgh, Pa., Ernest M. Hommel of the O. Hommel Company was elected president for a term of two years. Other officers elected were John Clark of Foote Mineral Co., first vice president; George Reuning of Big Savage Refractories Corp., second vice president; and James K. Martin of Posey Iron Works, managing director.

The objectives of this organization are to promote the ceramic industry in the state of Pennsylvania and attract students to ceramics as a vocation. Many of the member companies sponsor scholarships in ceramic engineering at the Pennsylvania State University as an inducement to study in the field of ceramics.

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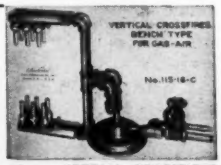
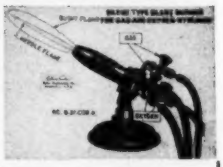
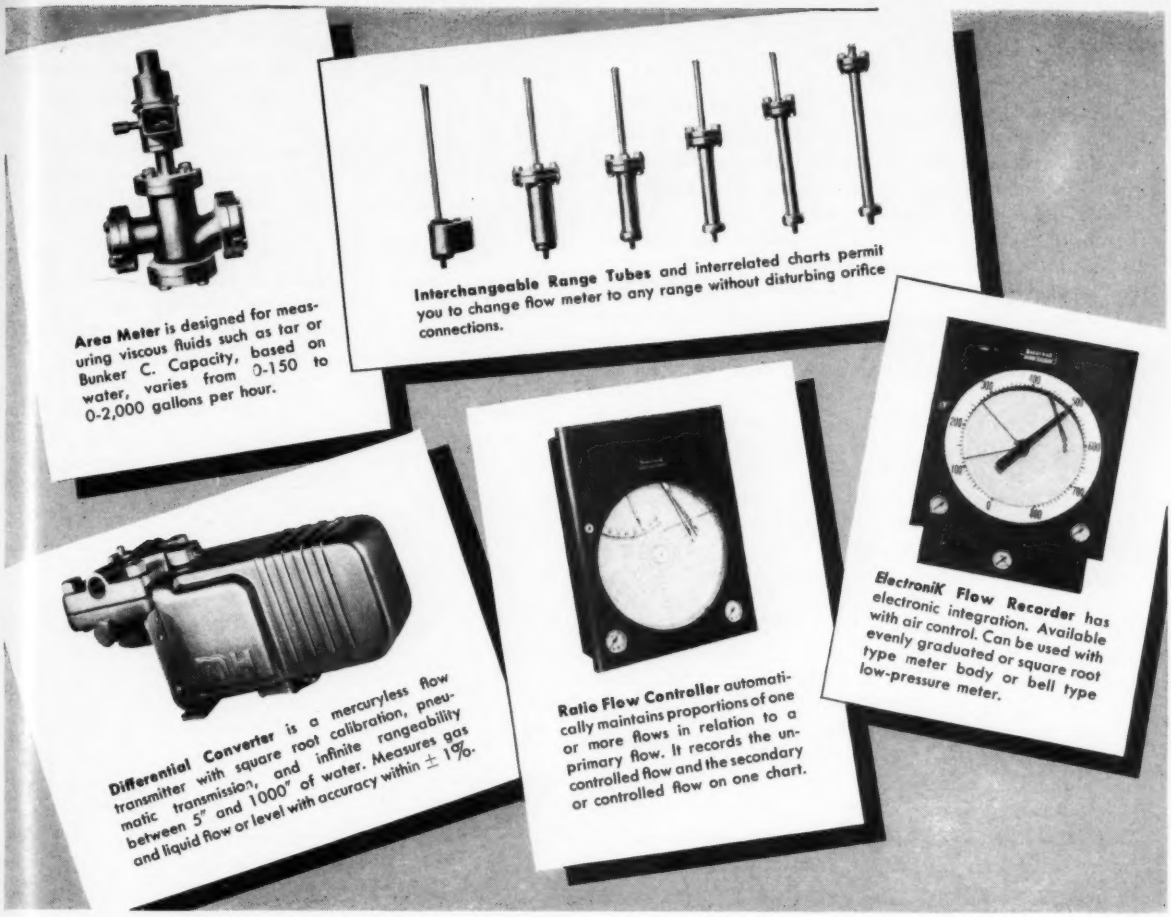


Above: SPECIAL CROSSFIRES
Below: BLAST BURNERS



EISLER ENGINEERING CO., INC.
742 So. 13TH ST., NEWARK 3, N. J.

Charles Eisler, Jr.
President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Differential Converter is a mercuryless flow transmitter with square root calibration, pneumatic transmission, and infinite rangeability between 5" and 1000" of water. Measures gas and liquid flow or level with accuracy within ± 1%.
Ratio Flow Controller automatically maintains proportions of one or more flows in relation to a primary flow. It records the uncontrolled flow and the secondary or controlled flow on one chart.
ElectroniK Flow Recorder has electronic integration. Available with air control. Can be used with evenly graduated or square root type meter body or bell type low-pressure meter.

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Eighteenth Conference . . .

(*Continued from page* 38)

controller, and a fogged lens will upset all of these items, although the recorder may show the temperature to be at an absurd value when actually it is not. Because of this, it is believed that thermocouples are considerably more reliable than radiation type instruments. True, the life of the thermocouple is limited to approximately 18 months, but its relatively trouble-free operation more than compensates for the continuing cost of replacement.

The signal lights incorporated into many forehearth control systems to indicate minimum or maximum fire are quite superfluous and definitely not worth the increased material cost or labor installation cost. If a forehearth is being operated properly, and is on control, both of the signal lights are energized. These lights should be energized only when out of control and at either minimum or maximum firing. The instrument can go only to more fire if at minimum or can go only to less fire if at maximum, so the signal lights are unnecessary. Careful use of dampers, blowers, and actual combustion mixture to give a firing condition in the middle of the firing range is a necessity if the firing is to be properly controlled and the instrument is to function as designed. Once the forehearth firing is properly set for a certain job, the signal lights are quite useless. The use of a draft guage is of more assistance than the lights.

Many practical changes were offered to improve the efficiency and practicality of instruments used in glasshouse operation.

The banquet on Thursday evening was held at the Urbana-Lincoln Hotel. It was a most enjoyable affair featuring a talk by Dr. Richard Dewey, Professor of Sociology, University of Illinois. Dr. Dewey had prepared a most interesting background for his talk by asking each member to write on separate cards what he considered the day's most significant and important problem.

As an answer to the problems submitted, Dr. Dewey offered as necessary a change in institutional philosophy related to such questions. The difficulties are not due necessarily to bad or even incompetent individuals but are the result of the times, state of culture or institutional attitude, some of which are commonly accepted. Institutional changes require time and can be corrected only by patience, education, complete understanding, and a willingness to correct the basic cause of trouble. The reasoning was expanded to include personnel problems as well as international ones. The banquet was an excellent climax to a very enjoyable meeting.

• American Potash & Chemical Corporation has opened a Great Lakes-Midwest territorial office at Chicago, according to an announcement by W. J. F. Francis, vice president in charge of sales.

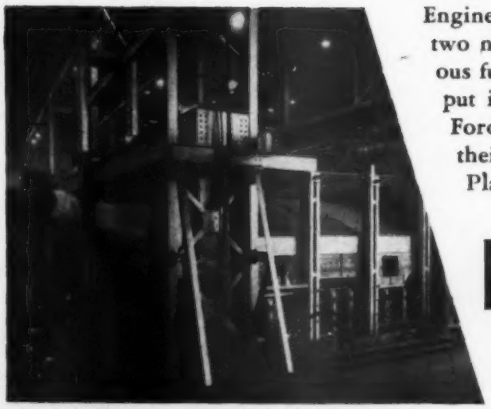
The new offices will service an area bounded roughly by North Dakota to Kansas on the west, Oklahoma to Arkansas on the south, and Kentucky to Michigan on the east. J. L. Anderson has been appointed manager.

GLASS MELTING FURNACES

by TECO for FORD MOTOR COMPANY

Machine end of plate glass furnace.

Completely designed and constructed by The Toledo Engineering Co., Inc., these two new modern continuous furnaces were recently put into operation by the Ford Motor Company at their Nashville, Tenn. Glass Plant.



Adjustable curtain—sheet glass furnace.

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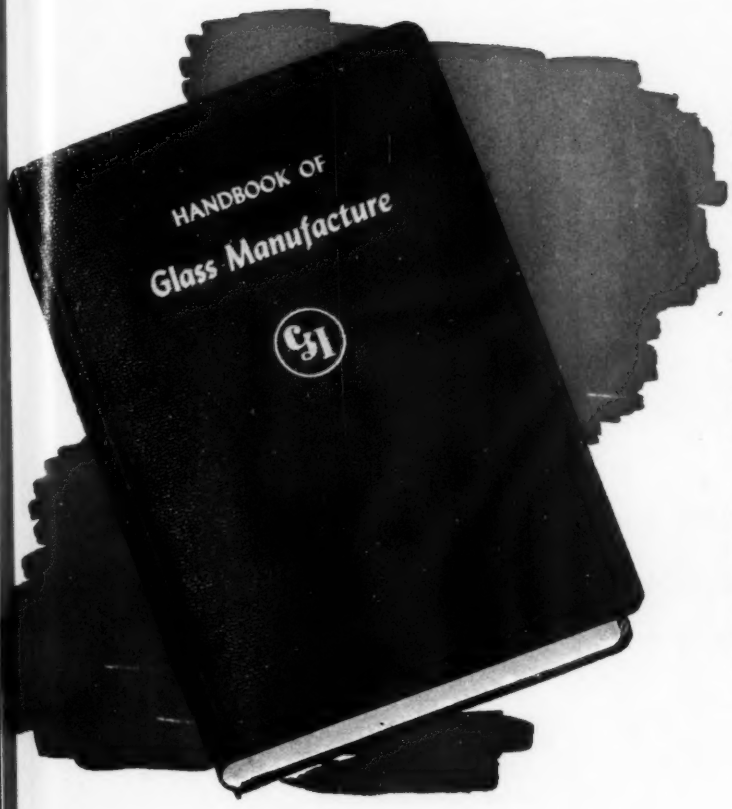

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